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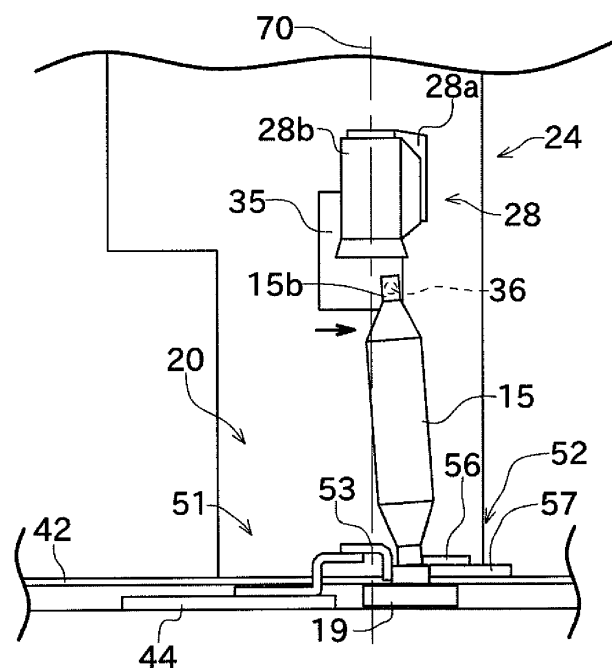
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(54) **Winding unit**

(57) A winding unit (11) includes a tray holder (51), a yarn-layer sensor (36), and a tray-position adjusting mechanism (58). The tray holder (51) holds a conveying tray (19). The yarn-layer sensor (36) detects a position of a yarn feeding bobbin (15) placed on the conveying

tray (19) and outputs a detection result. The tray-position adjusting mechanism (58) adjusts the position of the conveying tray (19) held by the tray holder (51) by operating the tray holder (51) based on the detection result output from the yarn-layer sensor (36).

FIG.11



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to winding units that unwind a yarn from a yarn feeding bobbin riding on a conveying tray and conveyed to the winding unit to form a package.

2. Description of the Related Art

[0002] Yarn winding devices that unwind a yarn from a yarn feeding bobbin and wind the unwound yarn onto a winding bobbin to form a package are known in the art. Such a yarn winding device is disclosed in, for example, Japanese Patent Application Laid-open No. 2009-286608.

[0003] A winding unit disclosed in Japanese Patent Application Laid-open No. 2009-286608 includes an unwinding assisting device that assists unwinding of a yarn from a yarn feeding bobbin. The unwinding assisting device includes a regulating member arranged above the yarn feeding bobbin. This regulating member assists unwinding of the yarn from the yarn feeding bobbin by being into contact with a balloon that is formed above the yarn feeding bobbin to apply an appropriate tension to the balloon.

[0004] An automatic winder disclosed in Japanese Patent Application Laid-open No. 2009-286608 includes a sensor for detecting a chase portion of the yarn feeding bobbin. The regulating member descends in synchronization with a descent of the chase portion. Thus, the regulating member follows the balloon even when a position where the balloon is formed changes as unwinding of the yarn from the yarn feeding bobbin advances and applies an appropriate tension to the balloon.

[0005] The automatic winder disclosed in Japanese Patent Application Laid-open No. 2009-286608 includes a tray on which the yarn feeding bobbin rides. The tray is conveyed along an appropriate conveying path to a bobbin loading section. Thus, the yarn feeding bobbin can be appropriately conveyed to a bobbin loading section.

[0006] It is preferable that a positional relationship between the yarn feeding bobbin and the regulating member is maintained constant so that the unwinding assisting device can apply an appropriate tension to the balloon. In this regard, in the conventional winding units, such as that disclosed in Japanese Patent Application Laid-open No. 2009-286608, that convey a yarn feeding bobbin on a tray, the tray that carries thereon a to-be-unwound yarn feeding bobbin is positioned precisely at a predetermined position (e.g., directly underneath the regulating member).

[0007] However, a yarn feeding bobbin supplied in an automatic winder can come in varying shapes and inner

diameters depending on the type of yarn used. Depending on a shape or an inner diameter of a yarn feeding bobbin, the yarn feeding bobbin may not ride upright on the tray. When a yarn feeding bobbin rides on the tray in a tilted manner, the regulating member may not properly contact the balloon formed above the yarn feeding bobbin, leading to application of an unstable unwinding tension on the yarn. This can result in decline in the quality of the package.

[0008] Japanese Utility Model Application Laid-open No. H6-65371 discloses a tray including a bobbin fixing member arranged on an outer periphery of a peg protruding from the tray. The bobbin fixing member is deformable so that it makes either a loose contact or a tight contact with a bobbin. The bobbin fixing member disclosed in Japanese Utility Model Application Laid-open No. H6-65371 enables the bobbin inserted to the tray to ride upright on the tray in an inexpensive way. However, depending on an inner diameter or a shape of a yarn feeding bobbin, the yarn feeding bobbin may not be fixed appropriately even by using the bobbin fixing member disclosed in Japanese Utility Model Application Laid-open No. H6-65371. Accordingly, in an environment where the yarn feeding bobbins can come in varying shapes and inner diameters depending on the type of the yarn, the configuration disclosed in Japanese Utility Model Application Laid-open No. H6-65371 may not necessarily achieve desired coupling alignment.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a winding unit, which is of the type that conveys a yarn feeding bobbin using a tray, capable of unwinding a yarn appropriately from the yarn feeding bobbin regardless of a riding state of the yarn feeding bobbin on the tray.

[0010] According to an aspect of the present invention, a winding unit that winds a yarn unwound from a yarn feeding bobbin riding on a conveying tray to form a package includes a tray holder that holds the conveying tray; a bobbin detector that detects a position of the yarn feeding bobbin riding on the conveying tray and outputs a detection result; and a tray-position adjusting mechanism that adjusts the position of the conveying tray held by the tray holder by operating the tray holder based on the detection result output from the bobbin detector.

[0011] The above and other objects, features, advantages and the technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

FIG. 1 is a front view showing an overall configuration

of an automatic winder including a plurality of winding units according to an embodiment of the present invention;

FIG. 2 is a side cross-sectional view of a conveying tray and a yarn feeding bobbin riding on the conveying tray;

FIG. 3 is a side view of one of the winding units;

FIG. 4 is a perspective view of an unwinding assisting device and its neighborhood;

FIG. 5 is a side view for explaining how a movable member is descended to follow a descent of a chase portion;

FIG. 6 is a plan view of a yarn feeding section;

FIG. 7 is a plan view of the yarn feeding section during discharging of a conveying tray;

FIG. 8 is a plan view showing a conveyance guide and its neighborhood;

FIG. 9 is a side view showing the conveying tray sandwiched between the conveyance guide and an elastic supporting section;

FIG. 10 is a side view showing the conveyance guide and its neighborhood in a state where coupling alignment control is not performed yet;

FIG. 11 is a side view showing a state where the yarn feeding bobbin blocks light falling on a yarn-layer sensor during the coupling alignment control;

FIG. 12 is a side view showing a state where the yarn feeding bobbin is at a bobbin detection position during the coupling alignment control;

FIG. 13 is a side view showing a state where the yarn feeding bobbin is at a target position during the coupling alignment control; and

FIG. 14 is a side view showing a state where a shorter yarn feeding bobbin is riding on the conveying tray.

DETAILED DESCRIPTION OF EMBODIMENTS

[0013] Exemplary embodiments of an automatic winder according to the present invention are explained below with reference to the accompanying drawings. FIG. 1 is a front view showing a schematic configuration of an automatic winder 10 according to an embodiment of the present invention.

[0014] As shown in FIG. 1, the automatic winder 10 includes a plurality of winding units 11 arranged side-by-side, a machine control device 12, a yarn-feeding-bobbin supplying device 13, and a doffer 14.

[0015] The machine control device 12 is capable of communicating with each of the winding units 11. An operator of the automatic winder 10 can collectively manage the winding units 11 by appropriately operating the machine control device 12.

[0016] Each of the winding units 11 unwinds a yarn from a yarn feeding bobbin 15 and winds a yarn 16, which is the yarn unwound from the yarn feeding bobbin 15, onto a winding bobbin while causing the yarn 16 to traverse. The winding bobbin around which the yarn 16 has been wound is called a package 18.

[0017] A yarn-feeding-bobbin conveying mechanism 40 that includes a belt conveyor or the like is arranged between the yarn-feeding-bobbin supplying device 13 and the winding units 11. The yarn-feeding-bobbin conveying mechanism conveys a plurality of conveying trays 19 (see FIG. 2) each carrying thereon the yarn feeding bobbin 15 individually to the winding units 11.

[0018] Each of the conveying trays 19 includes a peg 19a, a bobbin table 19b, and a base 19c. As shown in FIG. 2, the peg 19a has a substantially cylindrical shape or a substantially conical shape projecting in a substantially vertical direction. The peg 19a has an outer shape having such an outer diameter that allows insertion of the peg 19a into a core tube 15a of the yarn feeding bobbin 15. The bobbin table 19b has a substantially cylindrical shape that is coaxial with the peg 19a and a substantially horizontal top surface. The bobbin table 19b has an outer diameter that is larger than an outer diameter of the core tube 15a of the yarn feeding bobbin 15. Accordingly, as shown in FIG. 2, it is possible to insert the peg 19a into the core tube 15a of the yarn feeding bobbin 15 to thereby mount the yarn feeding bobbin 15 on the conveying tray 19 in a substantially upright orientation. The base 19c has a substantially cylindrical shape that is coaxial with the bobbin table 19b and an outside diameter that is still larger than that of the bobbin table 19b.

[0019] The yarn-feeding-bobbin supplying device 13 places the yarn feeding bobbins 15 one by one on the conveying trays 19 and delivers the yarn feeding bobbin 15 riding on the conveying tray 19 to the yarn-feeding-bobbin conveying mechanism. Thus, the yarn feeding bobbins 15 are supplied to each of the winding units 11.

[0020] When one of the winding units 11 has produced the package 18 that is fully wound (i.e., a preset amount of yarn is wound), the doffer 14 travels to this winding unit 11 to collect the fully-wound package and loads an empty winding bobbin. The machine control device 12 controls operations of the yarn-feeding-bobbin supplying device 13 and the doffer 14.

[0021] The configuration of the winding unit 11 is explained below with reference to FIG. 3.

[0022] Each of the winding units 11 includes a yarn feeding section 20 and a winding section 21.

[0023] The yarn feeding section 20 holds the yarn feeding bobbin 15 riding on the conveying tray 19 at a predetermined position. Accordingly, the yarn 16 can be unwound from the yarn feeding bobbin 15 appropriately.

[0024] The winding section 21 includes a cradle 23 and a winding drum 17.

[0025] The cradle 23 includes a pair of bearings. The cradle 23 rotatably supports a winding bobbin 22 (or the package 18) by arranging the winding bobbin 22 between the bearings. The cradle 23 is movable so as to bring an outer periphery of the package 18 supported by the cradle 23 into contact with an outer periphery of the winding drum 17.

[0026] The winding drum 17 causes the yarn 16 to

traverse on the surface of the package 18 and also causes the package 18 to rotate. The winding drum 17 is rotated by a not shown driving source (e.g., an electric motor). The package 18 is rotated by rotation of the winding drum 17 when the outer periphery of the package 18 is in contact with the winding drum 17. A not shown helical traverse groove is prepared in an outer peripheral surface of the winding drum 17. The yarn 16 unwound from the yarn feeding bobbin 15 is wound onto the surface of the package 18 while being traversed a predetermined width by the traverse groove. The package 18 having a predetermined winding width can be formed in this way.

[0027] Each of the winding units 11 includes an unwinding assisting device 24, a tension applying device 25, a yarn joining device 26, and a yarn-quality measuring device 27 that are arranged on a yarn feed path between the yarn feeding section 20 and the winding section 21 in this order from the side of the yarn feeding section 20. Furthermore, each of the winding units 11 includes a unit controller 39 that controls components of the winding unit 11. The unit controller 39 is capable of communicating with the machine control device 12. Hereinafter, an upstream side and a downstream side with respect to a direction in which the yarn 16 is fed are abbreviated to "upstream" and "downstream", respectively, in some cases.

[0028] The unwinding assisting device 24 includes a regulating member 28 capable of covering a top portion of the core tube 15a of the yarn feeding bobbin 15. The regulating member 28 is substantially cylindrical and arranged so as to come into contact with a balloon formed above a yarn layer on the yarn feeding bobbin 15. The balloon is a portion where the yarn 16 unwound from the yarn feeding bobbin 15 bulges because of centrifugal force. By bringing the regulating member 28 into contact with the balloon, a tension is applied to a balloon portion of the yarn 16, thereby preventing the yarn 16 from forming an excessively outwardly curved balloon. Accordingly, the yarn 16 can be unwound from the yarn feeding bobbin 15 appropriately.

[0029] The tension applying device 25 applies a predetermined tension to the running yarn 16. The tension applying device 25 according to the present embodiment is of gate type, in which movable combs are arranged in between fixed combs. The movable combs are urged so as to bring the comb teeth into a meshed state. The tension applying device 25 can improve quality of the package 18 by causing the yarn 16 to pass between the meshed teeth while bending the yarn 16 to thereby apply an appropriate tension to the yarn 16. Apart from such a gate-type tension applying device, for example, a disk-type tension applying device can be used as the tension applying device 25.

[0030] The yarn joining device 26 joins a lower yarn from the yarn feeding bobbin 15 side and an upper yarn from the package 18 side when the yarn 16 between the yarn feeding bobbin 15 and the package 18 is cut due to some reason. In the present embodiment, the yarn join-

ing device 26 is a splicer that joins yarn ends of the upper and lower yarns by utilizing a swirling airflow generated using compressed air. Apart from such a splicer, a mechanical knotter or the like can be used as the yarn joining device 26.

[0031] The yarn-quality measuring device 27 monitors a thickness of the yarn 16 using an appropriate sensor. A not shown cutter that cuts the yarn 16 immediately when the yarn-quality measuring device 27 detects an anomalous yarn thickness is arranged near the yarn-quality measuring device 27.

[0032] A lower-yarn catching pipe 29 and an upper-yarn catching pipe 30 are arranged above and below the yarn joining device 26, respectively. The lower-yarn catching pipe 29 catches and guides the yarn (lower yarn) coming from the yarn feeding bobbin 15. The upper-yarn catching pipe 30 catches and guides the yarn (upper yarn) coming from the package 18. A suction port 31 is arranged at a leading end of the lower-yarn catching pipe 29. A suction mouth 32 is arranged at a leading end of the upper-yarn catching pipe 30. A not shown appropriate negative-pressure source is connected to each of the catching pipes 29 and 30 so that a suction flow into the suction port 31 and a suction flow into the suction mouth 32 are generated.

[0033] With this configuration, when the yarn 16 is cut at a position between the yarn feeding bobbin 15 and the package 18, the lower-yarn catching pipe 29 catches the yarn coming from the yarn feeding bobbin 15 and introduces it to the yarn joining device 26, while the upper-yarn catching pipe 30 catches the yarn coming from the package 18 and introduces it to the yarn joining device 26. By driving the yarn joining device 26 in this state, the upper yarn and the lower yarn are joined, thereby bringing the yarn 16 between the yarn feeding bobbin 15 and the package 18 into a continuous state. Accordingly, winding of the yarn 16 onto the package 18 can be resumed.

[0034] The unwinding assisting device 24 is explained in detail below with reference to FIG. 4. The regulating member 28 of the unwinding assisting device 24 includes a fixed member 28a and a movable member 28b.

[0035] The fixed member 28a is fixed onto a body frame of the winding unit 11 via appropriate means. The fixed member 28a is substantially cylindrical. The movable member 28b is also substantially cylindrical and it is arranged coaxially with the fixed member 28a in such a manner as to cover the fixed member 28a from outside. The fixed member 28a and the movable member 28b are arranged so as to have a substantially vertical central axis. Hereinafter, an extension of the central axis (unwinding center) of the cylindrical fixed member 28a and the movable member 28b will be called a hypothetical line 70.

[0036] The unwinding assisting device 24 includes a not shown elevating mechanism that moves the movable member 28b in a substantially vertical direction along the axis. The unit controller 39 controls operations of the elevating mechanism.

[0037] The unwinding assisting device 24 includes a sensor holding member 35 that moves in one piece with the movable member 28b. A yarn-layer sensor 36 that detects a top end surface (hereinafter, "chase portion") of a yarn layer on the yarn feeding bobbin 15 is fixed onto the sensor holding member 35. The yarn-layer sensor 36 is a transmission-type photosensor that includes a light-emitting section 36a and a light-receiving section 36b. In other words, the yarn-layer sensor 36 detects the chase portion when the chase portion blocks light traveling from the light-emitting section 36a to the light-receiving section 36b. A result of detection output from the yarn-layer sensor 36 is transmitted to the unit controller 39.

[0038] The unit controller 39 performs control during yarn winding so as to descend the movable member 28b (and the sensor holding member 35) to a position where the yarn-layer sensor 36 detects the chase portion. This control makes it possible to descend the movable member 28b (and the sensor holding member 35) in a manner to follow a descent of the chase portion (i.e., a decrease in an amount of the yarn 16 on the yarn feeding bobbin 15) that results from unwinding of the yarn 16 from the yarn feeding bobbin 15 as shown in FIG. 5. Accordingly, a positional relationship between the chase portion and the movable member 28b can be maintained constant. Therefore, a uniform tension can be applied to the balloon and therefore the yarn 16 can be unwound from the yarn feeding bobbin 15 appropriately.

[0039] The configuration of the yarn feeding section 20 is explained below. The yarn feeding section 20 transports the conveying tray 19 conveyed through a bobbin conveying path into the winding unit 11 and holds the conveying tray 19 at a predetermined position.

[0040] As shown in FIG. 6, the bobbin conveying path includes a supplying conveyor 40 and a collecting conveyor 41. The supplying conveyor 40 conveys the conveying trays 19 each carrying thereon the yarn feeding bobbin 15 individually to the winding units 11. The collecting conveyor 41 collects the conveying trays 19 discharged from the winding units 11. The supplying conveyor 40 is arranged on a back side of the winding units 11, while the collecting conveyor 41 is arranged on a front side of the winding units 11.

[0041] The yarn feeding section 20 includes a passageway panel 42, a turntable 43, and a conveyance guide 44.

[0042] The passageway panel 42 is substantially horizontally oriented and arranged above conveying surfaces of the supplying conveyor 40 and the collecting conveyor 41. A tray passageway 45 that connects the supplying conveyor 40 and the collecting conveyor 41 is arranged in the passageway panel 42. The tray passageway 45 is an elongated gap of which width is substantially the same as the outside diameter of the bobbin table 19b.

[0043] The conveying trays 19 conveyed on the supplying conveyor 40 are taken into the tray passageway 45 one by one. The conveying tray 19 taken into the tray

passageway 45 is guided in such a manner that the bobbin table 19b of the conveying tray 19 is caught in the tray passageway 45 (see FIG. 6). As a result, the conveying tray 19 is conveyed along the tray passageway 45. Hereinafter, a direction in which the conveying trays 19 are conveyed through the tray passageway 45 from the supplying conveyor 40 toward the collecting conveyor 41 will be called a conveying direction. In the present embodiment, the conveying direction substantially corresponds to a front-to-rear direction of the winding unit 11 (i.e., the top-to-bottom direction as seen in FIG. 6).

[0044] The turntable 43 is arranged at an entrance of the tray passageway 45 at a position below the passageway panel 42. The turntable 43 has a disk shape as shown in FIG. 8 and a substantially-horizontal top surface. The turntable 43 is rotated in one direction (counterclockwise as seen in FIG. 6) by a driving force of a stepping motor (driving section) 47 transmitted via a cam mechanism 48 and a one-way clutch 49. The conveying tray 19 taken into the tray passageway 45 is placed on the turntable 43 to be conveyed through the tray passageway 45 downstream by rotation of the turntable 43. A motor controller 50 controls the stepping motor 47. The motor controller 50 is capable of communicating with the above-described unit controller 39.

[0045] The conveyance guide 44 that blocks the conveying tray 19 conveyed by the turntable 43 is arranged midway in the tray passageway 45.

[0046] More specifically, the conveyance guide 44 includes a retaining portion 44a that comes into contact with the base 19c of the conveying tray 19 conveyed along the tray passageway 45. The conveyance guide 44 is configured to block the conveying tray 19 by bringing the retaining portion 44a into contact with the conveying tray 19, which is conveyed by the turntable 43, from the downstream side in the conveying direction. FIG. 6 shows how the conveying tray 19 is blocked by the retaining portion 44a of the conveyance guide 44.

[0047] The yarn feeding section 20 of the winding unit 11 according to the present embodiment includes a tray holder 51. As shown in FIG. 3, the tray holder 51 holds the conveying tray 19 that carries thereon the yarn feeding bobbin 15 from which the yarn 16 is unwound by the winding unit 11. As shown in FIG. 6, the tray holder 51 holds the conveying tray 19 at a position downstream in the conveying direction with respect to a position where the conveyance guide 44 blocks the conveying tray 19. The yarn 16 can be unwound from the yarn feeding bobbin 15 riding on the conveying tray 19 appropriately when the conveying tray 19 is held by the tray holder 51 at an appropriate position. The configuration of the tray holder 51 will be described in detail later.

[0048] When the yarn 16 has been unwound from the yarn feeding bobbin 15 on the conveying tray 19 held by the tray holder 51, the yarn feeding bobbin 15 becomes empty (a state where no yarn is wound on the yarn feeding bobbin 15). When the yarn feeding bobbin 15 becomes empty, the yarn feeding section 20 discharges

the conveying tray 19 that carries thereon the empty yarn feeding bobbin 15 and takes in another one of the conveying trays 19 that carries thereon a not-yet-unwound one of the yarn feeding bobbins 15.

[0049] This operation is concretely described below. In the description below, it is assumed that a first one, a second one, and a third one of the conveying trays 19 are conveyed in this order. The conveyance guide 44 is pivotable clockwise and counterclockwise as seen in FIG. 6 by the driving force transferred from the stepping motor 47 via the cam mechanism 48. When it is detected that the yarn feeding bobbin 15 on the first one of the conveying trays 19 held by the tray holder 51 becomes empty, the unit controller 39 transmits a bobbin change signal to the motor controller 50. Upon receiving the bobbin change signal, the motor controller 50 controls the stepping motor 47 appropriately, thereby causing the conveyance guide 44 to pivot clockwise from the state shown in FIG. 6 via the cam mechanism 48.

[0050] As a result, as shown in FIG. 7, the first one of the conveying trays 19 is released from the tray holder 51 and pushed out by a push-out portion 44b formed on the conveyance guide 44 toward the collecting conveyor 41. The first one of the conveying trays 19 pushed out onto the collecting conveyor 41 is conveyed by the collecting conveyor 41 to be collected by the yarn-feeding-bobbin supplying device 13. Concurrently therewith, the second one of the conveying trays 19 that has been blocked by the retaining portion 44a of the conveyance guide 44 is taken into a downstream side in the conveying direction.

[0051] Subsequently, the motor controller 50 controls the stepping motor 47 appropriately, thereby causing the conveyance guide 44 to pivot counterclockwise from the state shown in FIG. 7 via the cam mechanism 48. As a result, the conveyance guide 44 returns to the state shown in FIG. 6. Accordingly, the tray holder 51 can now hold the second one of the conveying trays 19, which has been newly taken into, and the retaining portion 44a blocks the third one of the conveying trays 19 that is on the upstream side relative to the second one of the conveying trays 19.

[0052] As described above, the yarn feeding section 20 takes into, discharges, and holds the conveying trays 19 using rotation of the conveyance guide 44.

[0053] A configuration that is specific to the present embodiment is explained below.

[0054] First, as shown in FIG. 5, a situation where the yarn feeding bobbin 15 is upright with respect to the conveying tray 19 is discussed. The conventional winding units known to the inventor are based on a premise that the yarn feeding bobbin 15 is upright as in this situation. Accordingly, in such winding units, the conveying tray 19 that carries thereon the yarn feeding bobbin 15 is positioned at a position directly below the regulating member 28 (to be more precise, a position where the hypothetical line 70 coincides with an axis of the peg 19a of the conveying tray 19). This position (the position shown in FIG.

5) of the conveying tray 19 will be called a reference position of the conveying tray 19. Holding the conveying tray 19 at the reference position causes an axis of the yarn feeding bobbin 15 riding on the conveying tray 19 to coincide with the hypothetical line 70 (a central axis of the regulating member 28).

[0055] When this coincidence is achieved, it is possible to bring the regulating member 28 into contact with the balloon formed above the yarn feeding bobbin 15 appropriately, thereby performing appropriate yarn unwinding from the yarn feeding bobbin 15. The position of the yarn feeding bobbin 15 (in particular, a position of a leading end of the yarn feeding bobbin 15) is fixed so long as the axis of the yarn feeding bobbin 15 and the hypothetical line 70 coincide with each other as shown in FIG. 4. Therefore, in this state, the yarn-layer sensor 36 can detect the chase portion of the yarn feeding bobbin 15 reliably. Accordingly, it is possible to cause the movable member 28b to descend appropriately to follow a descent of the chase portion. As a result, a manner in which the balloon covers the top portion of the regulating member 28 becomes uniform, and therefore a uniform tension can be applied to the balloon.

[0056] Meanwhile, yarn feeding bobbins supplied to the winding units 11 come in varying shapes and inner diameters. There can be a case where the yarn feeding bobbin 15 is not inserted upright in the conveying tray 19 as shown in FIG. 10, for example. Accordingly, even when the conveying tray 19 is held at the reference position, the position of the yarn feeding bobbin 15 riding on the conveying tray 19, in particular the position of a leading end (which is the end on a side from which the yarn is unwound; hereinafter sometimes called "first end") 15b of the yarn feeding bobbin 15, is not fixed in practice.

[0057] If the position of the yarn feeding bobbin 15 is not fixed as described above, the yarn-layer sensor 36 fails to detect the position of the chase portion of the yarn feeding bobbin 15 reliably. As a result, the manner in which the regulating member 28 covers the top portion of the yarn feeding bobbin 15 varies. If this happens, the regulating member 28 is not brought into contact with the balloon formed above the yarn feeding bobbin 15 appropriately so that that an appropriate tension cannot be applied to the balloon.

[0058] In this regard, in the winding unit 11 according to the present embodiment, the position of the conveying tray 19 held by the yarn feeding section 20 is made adjustable.

[0059] This configuration is explained concretely below. As described above, the yarn feeding section 20 according to the present embodiment includes the tray holder 51 that holds the conveying tray 19 that carries thereon the yarn feeding bobbin 15. The tray holder 51 holds the conveying tray 19 by sandwiching between the conveyance guide 44 and an elastic supporting section 52.

[0060] As shown in FIGS. 6 and 9, the conveyance

guide 44 includes a tray contacting section 53 that comes into contact with a peripheral surface of the bobbin table 19b of the conveying tray 19 from the upstream side in the conveying direction. The tray contacting section 53 is formed of a sheet metal. As shown in FIG. 9, the tray contacting section 53 is bent at a portion where the tray contacting section 53 contacts the conveying tray 19 in a manner that an end surface of the sheet metal does not face the conveying tray 19. Forming the tray contacting section 53 in this way can prevent a damage to the conveying tray 19 because the end surface of the sheet metal does not contact the conveying tray 19.

[0061] As shown in FIG. 6, the elastic supporting section 52 includes a support arm 57 that is pivotable about a pivot shaft 54. The support arm 57 includes a not shown urging member that urges the support arm 57 clockwise as seen in FIG. 6. A stopper 55 that is to come into contact with the support arm 57 is arranged on the passageway panel 42. The stopper 55 prevents the support arm 57 from being pivoted unlimitedly by an urging force applied from the urging member. FIG. 7 shows how the stopper 55 blocks pivoting of the support arm 57. Retaining the support arm 57 with the stopper 55 at an appropriate position in this way prevents the support arm 57 from obstructing conveyance of the conveying tray 19.

[0062] The support arm 57 is arranged in a manner such that a side surface of the support arm 57 can come into contact with the peripheral surface of the bobbin table 19b of the conveying tray 19 from the downstream side in the conveying direction. Furthermore, the support arm 57 is urged clockwise as described above. Accordingly, the support arm 57 can elastically push its side surface against the peripheral surface of the bobbin table 19b of the conveying tray 19 from the downstream side in the conveying direction. Meanwhile, as shown in FIG. 9, the tray contacting section 53 of the conveyance guide 44 is in contact with the bobbin table 19b from the side opposite from the support arm 57 (i.e., from the upstream side in the conveying direction). Thus, the tray holder 51 according to the present embodiment holds the conveying tray 19 by elastically sandwiching the conveying tray 19 between a bobbin contacting section 56 of the elastic supporting section 52 and the side surface of the support arm 57.

[0063] The bobbin contacting section 56 is attached to a top surface of a leading end of the support arm 57. The bobbin contacting section 56 is arranged in a manner such that the bobbin contacting section 56 contacts a bottom end portion (more precisely, an outer periphery of a bottom end portion of the core tube 15a of the yarn feeding bobbin 15) of the yarn feeding bobbin 15 riding on the conveying tray 19 when the side surface of the support arm 57 comes into contact with the bobbin table 19b of the conveying tray 19. The bobbin contacting section 56 that is in contact with the bottom end portion of the core tube 15a of the yarn feeding bobbin 15 is shown in FIG. 9, for example. A portion of the bobbin contacting section 56 at which the bobbin contacting section 56 con-

tacts the yarn feeding bobbin 15 is made of a relatively soft material (more specifically, a resin). Accordingly, a damage to the yarn feeding bobbin 15 that could otherwise result from a contact with the bobbin contacting section 56 can be prevented.

[0064] The support arm 57 is urged clockwise. Accordingly, the bobbin contacting section 56 attached to the support arm 57 can elastically push the yarn feeding bobbin 15 from the downstream side against the conveying direction. Meanwhile, as described above, the tray contacting section 53 of the conveyance guide 44 is in contact with the bobbin table 19b from a side opposite to the side where the support arm 57 pushes the yarn feeding bobbin 15 (i.e., from the upstream side in the conveying direction). As a result, as shown in FIG. 9, the yarn feeding bobbin 15 is pushed by the bobbin contacting section 56 into press contact with the peg 19a of the conveying tray 19. The bobbin contacting section 56 can fix the yarn feeding bobbin 15 in terms of orientation by bringing the yarn feeding bobbin 15 into press contact with the conveying tray 19 in this way. Accordingly, an undesirable phenomenon that the orientation of the yarn feeding bobbin 15 changes during bobbin coupling alignment control (which will be described later) can be prevented more reliably.

[0065] The bobbin contacting section 56 of the elastic supporting section 52 in the above-described configuration can be considered as indirectly pushing the peg 19a of the conveying tray 19 with the yarn feeding bobbin 15 therebetween. Accordingly, the tray holder 51 according to the present embodiment can be considered as being configured to hold the conveying tray 19 by indirectly sandwiching the conveying tray 19 between the bobbin contacting section 56 of the elastic supporting section 52 and the tray contacting section 53 of the conveyance guide 44. Thus, not only the support arm 57 but also the bobbin contacting section 56 of the elastic supporting section 52 according to the present embodiment have a function of holding the conveying tray 19. Accordingly, the elastic supporting section 52 can hold the conveying tray 19 securely, thereby preventing tilting of the conveying tray 19.

[0066] As shown in FIG. 6, the tray contacting section 53 of the conveyance guide 44 and the support arm 57 and the bobbin contacting section 56 of the elastic supporting section 52 are arranged in almost a V-shape in plan view. As a result, the conveying tray 19 sandwiched between the tray contacting section 53 and the support arm 57 and the bobbin contacting section 56 is urged in a direction in which an angle between two sides of the V-shape increases. Consequently, the conveying tray 19 is pressed against an edge portion 45a of the tray passageway 45. Hence, the conveying tray 19 held by the tray holder 51 is supported on three points, which are the tray contacting section 53, the support arm 57 (and the bobbin contacting section 56), and the edge portion 45a of the tray passageway 45. Such a three-point support causes the conveying tray 19 to be held stably.

[0067] Meanwhile, as described above, it is possible to cause the conveyance guide 44 to pivot clockwise or counterclockwise by controlling the stepping motor. A situation where the conveyance guide 44 is slightly pivoted clockwise from the state shown in FIG. 6 is discussed below. This pivot motion causes the tray contacting section 53 of the conveyance guide 44 to move slightly upstream against the conveying direction. On the other hand, the bobbin contacting section 56 of the elastic supporting section 52 elastically pushes the conveying tray 19 from the downstream side against the conveying direction. As a result, the conveying tray 19 held by the tray holder 51 is pushed by the elastic supporting section 52 to move upstream against the conveying direction.

[0068] A situation where the conveyance guide 44 is slightly pivoted counterclockwise from the state shown in FIG. 6 is discussed below. This pivot motion causes the tray contacting section 53 of the conveyance guide 44 to move slightly downstream in the conveying direction with respect to the conveying tray 19. As a result, the conveying tray 19 is pushed by the tray contacting section 53 downstream in the conveying direction. The conveying tray 19 thus pushed by the tray contacting section 53 can move downstream in the conveying direction in such a manner as to push aside the bobbin contacting section 56 of the elastic supporting section 52.

[0069] As described above, according to the present embodiment, the conveying tray 19 held by the tray holder 51 can be moved upstream or downstream in the conveying direction by causing the conveyance guide 44 to pivot. Put another way, the position where the conveying tray 19 is held by the tray holder 51 can be adjusted by adjusting a pivot angle of the conveyance guide 44. The motor controller 50 can adjust the pivot angle of the conveyance guide 44 by controlling the stepping motor 47 via the cam mechanism 48. Hence, the motor controller 50, the stepping motor 47, and the cam mechanism 48 can be considered as forming a tray-position adjusting mechanism 58.

[0070] The coupling alignment control performed on the yarn feeding bobbin 15 by the tray holder 51 and the tray-position adjusting mechanism 58 configured as described above is explained in detail below.

[0071] A situation described above (an example of which is shown in FIG. 10) where the yarn feeding bobbin 15 is inserted into the conveying tray 19 in a tilted orientation can occur. Accordingly, even if the conveying tray 19 is held at the reference position (the position directly below the regulating member 28), the position (in particular, the position of the leading end 15b of the yarn feeding bobbin 15) of the yarn feeding bobbin 15 relative to the regulating member 28 cannot be fixed.

[0072] In this regard, the tray-position adjusting mechanism 58 is configured to perform the bobbin coupling alignment control. The bobbin coupling alignment control is performed by moving the conveying tray 19 so as to achieve a state (the state shown in FIG. 13) where the center of the leading end 15b of the yarn feeding bobbin

15 coincides with the hypothetical line 70 that extends through the axis of the regulating member 28. The position (the position shown in FIG. 13) of the yarn feeding bobbin 15 in the state where the center of the of the leading end 15b of the yarn feeding bobbin 15 coincides with the hypothetical line 70 extending through the axis of the regulating member 28 is assumed as a target position. Hence, the coupling alignment control according to the present embodiment is, put another way, control effected by positioning the yarn feeding bobbin 15 riding on the conveying tray 19 at the target position.

[0073] More specifically, even if the yarn feeding bobbin 15 is inserted into the conveying tray 19 in a tilted orientation, positional relationship between the leading end 15b of the yarn feeding bobbin 15 and the regulating member 28 is fixed so long as the leading end 15b of the yarn feeding bobbin 15 coincides with the hypothetical line 70 (i.e., so long as the yarn feeding bobbin 15 is positioned at the target position). Accordingly, the coupling alignment control makes it possible to appropriately bring the regulating member 28 into contact with the yarn 16 unwound from the yarn feeding bobbin 15 regardless of a tilt of the yarn feeding bobbin 15.

[0074] The coupling alignment control is concretely explained below. The coupling alignment control is performed when the tray holder 51 discharges the first one of the conveying trays 19 that carries thereon the yarn feeding bobbin 15 that has become empty and takes in the second one of the conveying trays 19 that carries thereon a not-yet-unwound one of the yarn feeding bobbins 15.

[0075] First, the tray-position adjusting mechanism 58 drives the tray holder 51 to thereby move the conveying tray 19 (the second one of the conveying trays 19 that carries thereon the not-yet-unwound one of the yarn feeding bobbins 15) held by the tray holder 51 in a first moving direction. The first moving direction in which the conveying tray 19 is to be moved is a direction in which the yarn feeding bobbin 15 approaches the yarn-layer sensor 36. For example, in the present embodiment, the yarn-layer sensor 36 is arranged on a front side of the winding unit 11. (on the right side as seen in FIG. 10; hereinafter "front side") with respect to the hypothetical line 70 as shown in FIG. 10 and other diagrams. Accordingly, in the present embodiment, the conveying tray 19 held by the tray holder 51 is moved toward the front side from the reference position. More specifically, the motor controller 50 controls the stepping motor 47 appropriately to cause the conveyance guide 44 to pivot counterclockwise as seen in FIG. 6, thereby moving the conveying tray 19 downstream in the conveying direction (i.e., almost toward the front side).

[0076] At a certain point in time, during movement of the conveying tray 19 toward the front side, the leading end 15b of the yarn feeding bobbin 15 blocks light traveling from the light-emitting section to the light-receiving section of the yarn-layer sensor 36 (as shown in FIG. 11). Put another way, the yarn-layer sensor 36 de-

fects the leading end 15b of the yarn feeding bobbin 15.

[0077] When the yarn-layer sensor 36 detects the leading end 15b of the yarn feeding bobbin 15, the tray-position adjusting mechanism 58 drives the tray holder 51, thereby moving the conveying tray 19 held by the tray holder 51 in a second moving direction opposite to the first moving direction. More specifically, the motor controller 50 controls the stepping motor 47 appropriately to cause the conveyance guide 44 to pivot clockwise as seen in FIG. 6, thereby moving the conveying tray 19 upstream against the conveying direction (i.e., almost toward a back side of the winding unit 11; hereinafter "back side"). Note that the motor controller 50 causes the conveyance guide 44 to pivot clockwise at a speed lower than that at which the conveyance guide 44 is pivoted counterclockwise. In other words, the tray-position adjusting mechanism 58 causes the conveying tray 19 to move toward the back side slowly.

[0078] At a certain point in time, during movement of the conveying tray 19 from the state shown in FIG. 11 toward the back side, the leading end 15b of the yarn feeding bobbin 15 does not block light traveling from the light-emitting section to the light-receiving section of the yarn-layer sensor 36 any more (as shown in FIG. 12). A position where the leading end 15b of the yarn feeding bobbin 15 goes out a detection range of the yarn-layer sensor 36 is hereinafter referred to as a bobbin detection position. The position (bobbin detection position) where the leading end 15b of the yarn feeding bobbin 15 goes out of the detection range of the yarn-layer sensor 36 can be detected accurately because the tray-position adjusting mechanism 58 causes the conveying tray 19 to move slowly. The yarn-layer sensor 36 can detect the position of the yarn feeding bobbin 15 in this way. Therefore, the yarn-layer sensor 36 can be considered as doubling as a bobbin detector.

[0079] The yarn-layer sensor 36 is positioned at a predetermined position set by the operator. Therefore, the leading end 15b of the yarn feeding bobbin 15 at the bobbin detection position will be positioned at the predetermined position corresponding to the position of the yarn-layer sensor 36. Accordingly, the yarn feeding bobbin 15 can be positioned at the target position by moving the yarn feeding bobbin 15 from the bobbin detection position for a predetermined distance.

[0080] The motor controller 50 in the present embodiment includes a storage section 59 that stores a pivot angle (through which the conveyance guide 44 is to pivot) of the conveyance guide 44 necessary to move the yarn feeding bobbin 15 from the bobbin detection position to the target position. In the above-described coupling alignment control, when it is detected that the leading end 15b of the yarn feeding bobbin 15 goes out of the detection range of the yarn-layer sensor 36 (the state shown in FIG. 12), the motor controller 50 of the tray-position adjusting mechanism 58 causes the conveyance guide 44 to pivot clockwise from the bobbin detection position through the pivot angle stored in the storage section 59.

By this control, the conveying tray 19 is moved for the predetermined distance from the state shown in FIG. 12 toward the back side (as shown in FIG. 13), thereby positioning the yarn feeding bobbin 15 at the target position.

[0081] A configuration in which the yarn-layer sensor 36 is movable can be employed. This configuration preferably includes an input section for receiving an input of a horizontal distance between a position after movement, or the position to which the yarn-layer sensor 36 is to move, and the hypothetical line 70 extending through the axis of the regulating member 28. The pivot angle stored in the storage section can be replaced with another value obtained from the horizontal distance input from the input section.

[0082] According to the coupling alignment control described above, it is possible to cause the center of the leading end 15b of the yarn feeding bobbin 15 to coincide with the hypothetical line 70 extending through the axis of the regulating member 28 regardless of how the yarn feeding bobbin 15 on the conveying tray 19 is tilted. Accordingly, the positional relationship between the leading end 15b of the yarn feeding bobbin 15 and the regulating member 28 can be fixed regardless of the tilt of the yarn feeding bobbin 15. Thus, the coupling alignment control makes it possible to bring the regulating member 28 into contact with the yarn 16 unwound from the yarn feeding bobbin 15 appropriately, thereby maintaining a uniform unwinding tension. Furthermore, the leading end 15b of the yarn feeding bobbin 15 is positioned relative to the regulating member 28. Accordingly, the yarn-layer sensor 36 can detect the chase portion of the yarn feeding bobbin 15 reliably. This makes it possible to cause the movable member 28b to descend to follow a descent of the chase portion, thereby maintaining the uniform unwinding tension. Consequently, unwinding of the yarn 16 from the yarn feeding bobbin 15 is stabilized, enabling high-speed unwinding.

[0083] Meanwhile, the tray-position adjusting mechanism 58 includes a position sensor 60 for defining an origin of the stepping motor 47. The position sensor 60 detects whether the conveyance guide 44 has pivoted by a predetermined pivot angle. The position sensor 60 can be attached to the conveyance guide 44; alternatively, the position sensor can be attached to the cam mechanism 48, for example. In the above-described coupling alignment control, when the motor controller 50 detects that the conveyance guide 44 has pivoted through the predetermined pivot angle based on information output from the position sensor 60, the motor controller 50 defines a rotational position of the stepping motor 47 where the predetermined pivot angle is achieved as the origin, and controls the stepping motor 47 with reference to this origin. Alternatively, an encoder-type position sensor capable of detecting a rotational position of the stepping motor 47 can be used to obtain an actual value of the pivot angle of the conveyance guide 44 by measurement so that the conveyance guide 44 is driven based on the measured pivot angle. When such an encoder-type po-

sition sensor is used, the pivot angle of the conveyance guide 44 can be controlled accurately, and therefore the conveying tray 19 can be positioned at the target position accurately. In the present embodiment, the stepping motor 47 is employed as the driving source of the conveyance guide 44. Accordingly, the pivot angle of the conveyance guide 44 can be controlled minutely and easily.

[0084] Meanwhile, the yarn feeding bobbin 15 that rides on the conveying tray 19 can come in varying shapes. Accordingly, a shorter yarn feeding bobbin may ride on the conveying tray. In the above-described coupling alignment control, the yarn-layer sensor 36 cannot detect the yarn feeding bobbin 15 when the leading end 15b of the yarn feeding bobbin 15 is at a level lower than the yarn-layer sensor 36.

[0085] In this regard, the above-described coupling alignment control can be performed as follows. When the yarn-layer sensor 36 does not detect the yarn feeding bobbin 15 even when the conveying tray 19 is moved to a position where the yarn-layer sensor 36 should detect the yarn feeding bobbin 15, the unit controller 39 performs control so as to cause the yarn-layer sensor 36 (and the movable member 28b) to descend a predetermined distance. When the yarn-layer sensor 36 has descended, the tray-position adjusting mechanism 58 retries the above-described coupling alignment control. Accordingly, the yarn-layer sensor 36 can detect the yarn feeding bobbin 15 reliably even when the shorter yarn feeding bobbin 15 is riding on the conveying tray 19.

[0086] As explained above, the winding unit 11 according to the present embodiment includes the tray holder 51, the yarn-layer sensor 36, and the tray-position adjusting mechanism 58. The tray holder 51 holds the conveying tray 19. The yarn-layer sensor 36 detects the position of the yarn feeding bobbin 15 riding on the conveying tray 19 and outputs a detection result. The tray-position adjusting mechanism 58 adjusts the position of the conveying tray 19 held by the tray holder 51 by moving the tray holder 51 based on the detection result output from the yarn-layer sensor 36.

[0087] Positioning the yarn feeding bobbin 15 in the winding unit 11 of this type that conveys bobbins using trays can be performed by adjusting the position of the conveying tray 19 in this way. This adjustment stabilizes an unwinding tension on the yarn 16 unwound from the yarn feeding bobbin 15, thereby enabling high-speed unwinding.

[0088] The winding unit 11 according to the present embodiment has the following configuration. That is, the tray-position adjusting mechanism 58 includes the stepping motor 47 that drives the tray holder 51, and the motor controller 50. The motor controller 50 moves the tray holder 51 by controlling the stepping motor 47 based on a result of detection of the yarn-layer sensor 36 so as to position the first end of the yarn feeding bobbin 15 at the preset target position.

[0089] This configuration makes it possible to position the yarn feeding bobbin 15 at the predetermined position.

Accordingly, the yarn 16 can be appropriately unwound from the yarn feeding bobbin 15.

[0090] In the winding unit 11 according to the present embodiment, the yarn-layer sensor 36 detects the first end (the leading end 15b) of the yarn feeding bobbin 15.

[0091] By adjusting the position of the conveying tray 19 based on a result of detection of the first end of the yarn feeding bobbin 15, the first end can be positioned at the target position accurately.

[0092] The winding unit 11 according to the present embodiment has the following configuration. That is, the winding unit 11 includes the unwinding assisting device 24 that assists unwinding of the yarn 16 from the yarn feeding bobbin 15. The unwinding assisting device 24 includes the regulating member 28 that comes into contact with the balloon that is formed during unwinding of the yarn 16 from the yarn feeding bobbin 15. The target position is determined with reference to an unwinding center of the regulating member 28.

[0093] An optimum balloon can be formed by positioning the first end of the yarn feeding bobbin 15 relative to the regulating member 28 in this manner.

[0094] The winding unit 11 according to the present embodiment has the following configuration. That is, the regulating member 28 is a cylindrical member. The winding unit 11 further includes the storage section 59. The storage section 59 can store a driving amount of the tray holder 51 (concretely, the pivot angle of the conveyance guide 44) necessary to move the yarn feeding bobbin 15 from the position where the yarn-layer sensor 36 detects the yarn feeding bobbin 15 to a target position where the center of the first end of the yarn feeding bobbin 15 coincides with the axis of the cylindrical member. The motor controller 50 drives the stepping motor 47 so as to position the first end of the yarn feeding bobbin 15 at the target position based on the position of the conveying tray 19 at which the yarn-layer sensor 36 detects the yarn feeding bobbin 15 and the driving amount stored in the storage section 59.

[0095] An amount of movement of the conveying tray 19 necessary to position the yarn feeding bobbin 15 at the target position can be set in advance in this manner. This presetting makes it possible to perform accurate positioning of the first end of the yarn feeding bobbin 15 at the target position by simple control.

[0096] The winding unit 11 according to the present embodiment has the following configuration. That is, the regulating member 28 and the yarn-layer sensor 36 are vertically movable in one piece. The yarn-layer sensor 36 detects the yarn layer (chase portion) of the yarn feeding bobbin 15 to determine the position after movement of the regulating member 28.

[0097] Cost reduction can be achieved because the single sensor functions not only as the bobbin detector but also as the yarn-layer detector as described above.

[0098] In the winding unit 11 according to the present embodiment, the unit controller 39 causes the yarn-layer sensor 36 to move downward when the first end of the

yarn feeding bobbin 15 is undetected by the yarn-layer sensor 36 in position adjustment of the conveying tray 19.

[0099] This control enables, even when a short yarn feeding bobbin is supplied, detection of the first end of the yarn feeding bobbin.

[0100] The winding unit 11 according to the present embodiment has the following configuration. That is, the tray holder 51 includes the conveyance guide 44 that comes into contact with the conveying tray 19 from the first direction and pivots to thereby convey the conveying tray 19, and the elastic supporting section 52 that elastically pushes the conveying tray 19 from the second direction opposite to the first direction. The stepping motor 47 drives the conveyance guide 44.

[0101] With this configuration, moving the conveying tray 19 downstream is performed by the stepping motor 47 by driving the conveyance guide 44, while moving the conveying tray 19 upstream is performed by the elastic force exerted by the elastic supporting section 52. Put another way, the position of the conveying tray 19 is adjustable in both a forward direction and a rearward direction of the conveying tray 19 using the single stepping motor 47. Furthermore, the conveying tray 19 is sandwiched between the conveyance guide 44 and the elastic supporting section 52 to thus be fixed securely. Accordingly, accuracy in position adjustment of the conveying tray 19 can be increased.

[0102] In the winding unit 11 according to the present embodiment, the elastic supporting section 52 includes the bobbin contacting section 56 that comes into contact with the core tube 15a of the yarn feeding bobbin 15 to thereby indirectly push the conveying tray 19 with the core tube 15a therebetween.

[0103] This configuration makes it possible to press the yarn feeding bobbin 15 against the conveying tray 19. Accordingly, accurate positioning can be performed with the yarn feeding bobbin 15 fixed.

[0104] The winding unit 11 according to the present embodiment has the following configuration. That is, the elastic supporting section 52 includes the support arm 57 that pushes the conveying tray 19 by contacting any one of the conveying tray 19 and the core tube 15a of the yarn feeding bobbin 15, the urging member that urges the support arm 57, and the stopper 55 that defines a limit for movement of the support arm 57 urged by the urging member.

[0105] With this configuration, the tray holder 51 that holds the conveying tray 19 can be implemented in a simple configuration. Furthermore, provision of the stopper 55 prevents overrange of the support arm 57. Provision of the stopper 55 also prevents the support arm 57 from obstructing conveyance of the conveying tray 19.

[0106] The winding unit 11 according to the present embodiment has the following configuration. That is, the conveyance guide 44 is driven by the stepping motor 47. The winding unit 11 includes the position sensor 60 that detects the position of the conveyance guide 44.

[0107] Using the stepping motor as the driving source

facilitates control of the conveyance guide.

[0108] Although some exemplary embodiments of the present invention are described above, the configurations disclosed therein can be modified as described below, for example.

[0109] In the tray holder 51 according to the above-described embodiment, the elastic supporting section 52 brings the support arm 57 and the bobbin contacting section 56 into contact with the conveying tray 19 and the core tube 15a of the yarn feeding bobbin 15, respectively. Alternatively, a configuration in which the side surface of the support arm 57 does not contact the conveying tray 19 when the bobbin contacting section 56 contacts the core tube 15a of the yarn feeding bobbin 15 can be employed. In other words, a configuration in which direct contact between the elastic supporting section 52 and the conveying tray 19 does not occur can be employed. Even with this configuration, the bobbin contacting section 56 of the elastic supporting section 52 can indirectly push the conveying tray 19 with the core tube 15a of the yarn feeding bobbin 15 therebetween. Accordingly, the conveying tray 19 can be arranged (indirectly) between the conveyance guide 44 and the elastic supporting section 52 to thus be held therebetween.

[0110] The support arm 57 and the bobbin contacting section 56 are not necessarily separate members, that is, they can be integrated into one piece.

[0111] A configuration in which the conveyance guide 44 is brought into contact with the yarn feeding bobbin 15 can be employed in lieu of the configuration in which the elastic supporting section 52 is brought into contact with the yarn feeding bobbin 15. Put another way, a configuration in which the conveyance guide 44 includes the bobbin contacting section 56 can be employed.

[0112] Further alternatively, a configuration in which both the conveyance guide 44 and the elastic supporting section 52 are brought into direct contact with the conveying tray 19 with the bobbin contacting section 56 omitted can be employed. However, when this configuration is employed, an effect provided by the bobbin contacting section 56 of fixing the yarn feeding bobbin 15 by bringing the yarn feeding bobbin 15 into press contact with the peg 19a of the conveying tray 19 cannot be obtained. Accordingly, when the bobbin contacting section 56 is omitted, it is preferable to fix the yarn feeding bobbin 15 to the conveying tray 19 with some other means. For example, a configuration in which the conveying tray includes a bobbin fixing member as in Japanese Utility Model Application Laid-open No. H6-65371 can be employed.

[0113] The configuration for driving the tray holder 51 is not limited to that described above. For example, a configuration in which the tray holder 51 is driven using a gear can be employed in lieu of the configuration in which the tray holder 51 is driven by the stepping motor via the cam mechanism. The driving source of the tray holder 51 is not limited to the stepping motor, and an appropriate servo motor can alternatively be used.

[0114] The motor controller 50 can be implemented as a part of a function provided by the unit controller 39. A configuration in which the unit controller 39 includes the storage section 59 can be employed in lieu of the configuration in which the motor controller 50 includes the storage section 59.

[0115] In the above-described embodiment, the yarn-layer sensor 36 is arranged on the front side of the hypothetical line 70. Alternatively, the yarn-layer sensor 36 can be arranged on the back side of the hypothetical line 70. Moreover, a sensor (bobbin detector) for detecting the yarn feeding bobbin 15 during the coupling alignment control can be provided independently from the yarn-layer sensor 36.

[0116] In the above-described embodiment, the coupling alignment control is described as being performed when the tray holder 51 takes in a not-yet-unwound one of the yarn feeding bobbins 15. However, timing for performing the coupling alignment control is not limited thereto. The coupling alignment control can be performed at any required timing.

[0117] According to an aspect of the present invention, there is provided a winding unit that winds a yarn unwound from a yarn feeding bobbin riding on a conveying tray to form a package. The winding unit includes a tray holder, a bobbin detector, and a tray-position adjusting mechanism. The tray holder holds the conveying tray. The bobbin detector detects a position of the yarn feeding bobbin riding on the conveying tray and outputs a detection result. The tray-position adjusting mechanism adjusts the position of the conveying tray held by the tray holder by operating the tray holder based on the detection result output from the bobbin detector.

[0118] According to the above aspect, positioning of the yarn feeding bobbin in the winding unit of this type that conveys bobbins using trays can be performed by adjusting the position of the conveying tray in this way. Such adjustment leads to stabilizing an unwinding tension on the yarn unwound from the yarn feeding bobbin, thereby enabling high-speed unwinding.

[0119] According to another aspect of the present invention, it is preferable that the tray-position adjusting mechanism includes a driving section that drives the tray holder and a controller that operates the tray holder by controlling the driving section so as to position a first end of the yarn feeding bobbin at a preset target position based on the detection result output from the bobbin detector. The first end is an end on a side from which the yarn is unwound from the yarn feeding bobbin.

[0120] According to the above aspect, the yarn feeding bobbin can be positioned at a predetermined position. Accordingly, the yarn can be appropriately unwound from the yarn feeding bobbin.

[0121] According to still another aspect of the present invention, it is preferable that the bobbin detector detects the first end of the yarn feeding bobbin.

[0122] According to the above aspect, the first end can be positioned at the target position accurately by adjust-

ing the position of the conveying tray based on a result of detection of the first end of the yarn feeding bobbin.

[0123] According to still another aspect of the present invention, it is preferable that the winding unit includes an unwinding assisting device that assists unwinding of the yarn from the yarn feeding bobbin. The unwinding assisting device includes a regulating member that comes into contact with a balloon that is formed during unwinding of the yarn from the yarn feeding bobbin. The target position is determined with reference to an unwinding center of the regulating member.

[0124] According to the above aspect, an optimum balloon can be formed by positioning the first end of the yarn feeding bobbin relative to the regulating member in this manner.

[0125] According to still another aspect of the present invention, it is preferable that the regulating member is a cylindrical member, and the winding unit further includes a storage section that stores therein a driving amount of the tray holder. The driving amount is an amount the tray holder is to be driven to move the yarn feeding bobbin from a position where the bobbin detector detects the yarn feeding bobbin to a target position where a center of the first end of the yarn feeding bobbin coincides with an axis of the cylindrical regulating member. The controller drives the driving section so as to position the first end of the yarn feeding bobbin at the target position based on the position of the conveying tray where the bobbin detector detects the yarn feeding bobbin and the driving amount stored in the storage section.

[0126] According to the above aspect, an amount of movement of the conveying tray necessary to position the yarn feeding bobbin at the target position can be set in advance in this manner. This presetting makes it possible to perform accurate positioning of the first end of the yarn feeding bobbin at the target position by simple control.

[0127] According to still another aspect of the present invention, it is preferable that the regulating member and the bobbin detector are vertically movable in one piece. The bobbin detector doubles as a yarn-layer detector that detects a yarn layer on the yarn feeding bobbin to determine a position after movement of the regulating member. The position after movement is a position to which the regulating member is to move.

[0128] According to the above aspect, cost reduction can be achieved because the single sensor functions not only as the bobbin detector but also as the yarn-layer detector as described above.

[0129] According to still another aspect of the present invention, the controller preferably causes the bobbin detector to move downward when the first end of the yarn feeding bobbin is undetected by the bobbin detector during adjustment of the position of the conveying tray.

[0130] According to the above aspect, such control enables, even when a shorter yarn feeding bobbin is supplied, detection of the first end of the yarn feeding bobbin.

[0131] According to still another aspect of the present

invention, it is preferable that the tray holder includes a conveyance guide that comes into contact with the conveying tray from a first direction and pivots to thereby convey the conveying tray, and an elastic supporting section that elastically pushes the conveying tray from a second direction opposite to the first direction. The driving section drives the conveyance guide.

[0132] According to the above aspect, moving the conveying tray in a forward direction of the conveying tray is performed by the driving section by driving the conveyance guide, while moving the conveying tray in a rearward direction of the conveying tray is performed by elastic force exerted by the elastic supporting section. Put another way, the position of the conveying tray is adjustable in both the forward direction and the rearward direction using the single driving section. Furthermore, the conveying tray is arranged between the conveyance guide and the elastic supporting section to thus be fixed securely. Accordingly, accuracy in position adjustment of the conveying tray can be increased.

[0133] According to still another aspect of the present invention, any one of the elastic supporting section and the conveyance guide preferably includes a bobbin contacting section that comes into contact with a core tube of the yarn feeding bobbin to thereby indirectly push the conveying tray with the core tube therebetween.

[0134] According to the above aspect, it is possible to press the yarn feeding bobbin against the conveying tray. Accordingly, accurate positioning can be performed with the yarn feeding bobbin fixed.

According to still another aspect of the present invention, it is preferable that the elastic supporting section includes a support arm that pushes the conveying tray by contacting any one of the conveying tray and the core tube of the yarn feeding bobbin, an urging member that urges the support arm, and a stopper that defines a limit for movement of the support arm urged by the urging member.

[0135] According to the above aspect, the tray holder that holds the conveying tray can be implemented in a simple configuration. Furthermore, provision of the stopper prevents overrange of the support arm. Provision of the stopper also prevents the support arm from obstructing conveyance of the conveying tray.

[0136] According to still another aspect of the present invention, it is preferable that the driving section is a stepping motor that drives the conveyance guide. The winding unit further includes a position sensor that detects a position of the conveyance guide.

[0137] According to the above aspect, by employing the stepping motor as the driving source, driving control of the conveyance guide can be performed easily.

[0138] Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching

herein set forth.

Claims

1. A winding unit (11) that winds a yarn (16) unwound from a yarn feeding bobbin (15) riding on a conveying tray (19) to form a package (18), the winding unit (11) comprising:
 - a tray holder (51) that holds the conveying tray (19);
 - a bobbin detector (36) that detects a position of the yarn feeding bobbin (15) riding on the conveying tray (19) and outputs a detection result; **characterized by**
 - a tray-position adjusting mechanism (58) that adjusts the position of the conveying tray (19) held by the tray holder (51) by moving the tray holder (51) based on the detection result output from the bobbin detector (36).
2. The winding unit (11) according to Claim 1, **characterized in that** the tray-position adjusting mechanism (58) includes a driving section (47) that drives the tray holder (51), and a controller (50) that controls the driving section (47) so as to position a first end (15b) of the yarn feeding bobbin (15) at a preset target position based on the detection result output from the bobbin detector (36) to thereby move the tray holder (51), the first end (15b) being an end on a side from which the yarn is unwound from the yarn feeding bobbin (15).
3. The winding unit (11) according to Claim 2, **characterized in that** the bobbin detector (36) detects the first end (15b) of the yarn feeding bobbin (15).
4. The winding unit (11) according to Claim 3, further comprising an unwinding assisting device (24) that assists unwinding of the yarn (16) from the yarn feeding bobbin (15), **characterized in that** the unwinding assisting device (24) includes a regulating member (28) that comes into contact with a balloon that is formed during unwinding of the yarn (16) from the yarn feeding bobbin (15), and the target position is determined with reference to an unwinding center of the regulating member (28).
5. The winding unit according to Claim 4, further comprising a storage section (59), **characterized in that** the regulating member (28) is a cylindrical member, the storage section (59) stores therein a driving amount of the tray holder (51), the driving amount being an amount for which the tray holder (51) needs to be driven to move the yarn feeding bobbin (15) from a position where the bobbin detector (36) de-

- fects the yarn feeding bobbin (15) to a target position where a center of the first end (15b) of the yarn feeding bobbin (15) coincides with an axis (70) of the cylindrical regulating member (28), and the controller drives (50) the driving section (47) so as to position the first end (15b) of the yarn feeding bobbin (15) at the target position based on the position of the conveying tray (19) where the bobbin detector (36) detects the yarn feeding bobbin (15) and the driving amount stored in the storage section (59).
6. The winding unit according to Claim 5, **characterized in that** the regulating member (28) and the bobbin detector (36) are vertically movable in one piece, and the bobbin detector (36) doubles as a yarn-layer detector, the yarn-layer detector detecting a yarn layer on the yarn feeding bobbin (15) to determine a position after movement of the regulating member (28), the position after movement being a position to which the regulating member (28) is to move.
 7. The winding unit according to Claim 6, **characterized in that** the controller (50) causes the bobbin detector (36) to move downward when the bobbin detector (36) can not detect the first end (15b) of the yarn feeding bobbin (15) during adjustment of the position of the conveying tray (19).
 8. The winding unit according to any one of Claims 2 to 7, **characterized in that** the tray holder (51) includes a conveyance guide (44) that comes into contact with the conveying tray (19) from a first direction and pivots to thereby convey the conveying tray (19), and an elastic supporting section (52) that elastically pushes the conveying tray (19) from a second direction opposite to the first direction, and the driving section (47) drives the conveyance guide (44) when moving the tray holder (51).
 9. The winding unit according to Claim 8, **characterized in that** any one of the elastic supporting section (52) and the conveyance guide (44) includes a bobbin contacting section (56) that comes into contact with a core tube of the yarn feeding bobbin (15) to thereby indirectly push the conveying tray (19) with the core tube therebetween.
 10. The winding unit according to Claim 8 or 9, wherein the elastic supporting section (52) includes a support arm (57) that supports the conveying tray (19) by contacting any one of the conveying tray and the core tube of the yarn feeding bobbin (15), an urging member that urges the support arm (57), and a stopper (55) that defines a limit for movement of the support arm (57) urged by the urging member.
 11. The winding unit according to Claim 10, further comprising a position sensor (60) that detects a position of the conveyance guide (44), **characterized in that** the driving section is a stepping motor that drives the conveyance guide (44).
 12. Method for operating a winding unit (11) that winds a yarn (16) unwound from a yarn feeding bobbin (15), which rides on a conveying tray (19) for forming a package (18) **characterized by** the following steps:
 - holding the conveying tray (19) by a tray holder (51);
 - detecting a position of the yarn feeding bobbin (15), which rides on the conveying tray (19) and generating a detection result;
 - adjusting the position of the conveying tray (19) by moving the tray holder (51) based on the detection result generated.
 13. Method according to claim 12 **characterized by**
 - controlling the position of the yarn feeding bobbin (15) to position a first end (15b) of the yarn feeding bobbin (15) at a preset target position based on the detection result by moving the tray holder (51) accordingly, wherein the first end (15b) is the end on a side from which the yarn is unwound from the yarn feeding bobbin (15).
 14. Method according to claim 12 or 13, **characterized in that** the position of the first end (15b) of the yarn feeding bobbin (15) is used in detecting the position of the yarn feeding bobbin (15).
 15. Method according to claims 12, 13 or 14, wherein an unwinding assisting device (24) assists in unwinding of the yarn (16) from the yarn feeding bobbin (15), **characterized in that** the unwinding assisting device (24) includes a regulating member (28) that contacts with a balloon, which is formed during unwinding of the yarn (16) from the yarn feeding bobbin (15) and determining the target position with reference to an unwinding center of the regulating member (28).
 16. Method according to claim 15 for operating a winding unit (11) with a storage section (59) and a cylindrical regulating member (28) **characterized by**
 - storing a driving amount of the tray holder, the driving amount being an amount for which the tray holder (51) needs to be driven to move the yarn feeding bobbin (15) from a position where the bobbin detector (36) detects the yarn feeding bobbin (15) to a target position where a center of the first end (15b) of the yarn feeding bobbin coincides with an axis (70) of the cylindrical regulating member (28), and

positioning the first end (15b) of the yarn feeding bobbin (15) at the target position based on the position of the conveying tray (19) where the bobbin detector (36) detects the yarn feeding bobbin (15) and the driving amount stored in the storage section (59). 5

17. Method according to claims 12, 13, 14, 15 or 16, **characterized in that** the regulation member (28) and the bobbin detector (36) are moving together vertically and the bobbin detector (36) additionally serves as yarn-layer detector detecting a yarn layer on the yarn feeding bobbin (15) to determine a position to which the regulating member (28) should move. 10 15

18. Method according to claim 17, **characterized in that** the controller (50) causes the bobbin detector (36) can not detect the first end (15b) of the yarn feeding bobbin (15) during adjustment of the position of the conveying tray (19). 20

19. Method according to claims 13, 14, 15, 16, 17 or 18 **characterized by** the further steps:

- contacting the conveying tray (19) with a conveyance guide (44) of the tray holder (51) from a first direction 25
- conveying the conveying tray (19) by pivoting of the conveyance guide (44)
- elastically pushing the conveying tray (19) by an elastic supporting section (52) from a second direction opposite to the first direction and 30
- moving the tray holder (51) by driving the conveyance guide (44) with the driving section. 35

20. Method according to claim 19 **characterized in that** the conveying tray (19) is indirectly pushed by a bobbin contacting section (56) arranged at the elastic support section (52) or the conveyance guide (44), which contacts a core tube of the yarn feeding bobbin (15) while the core tube of the yarn feeding bobbin (15) is hold between the bobbin contacting section (56) and the conveying tray (19). 40 45

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FIG.1

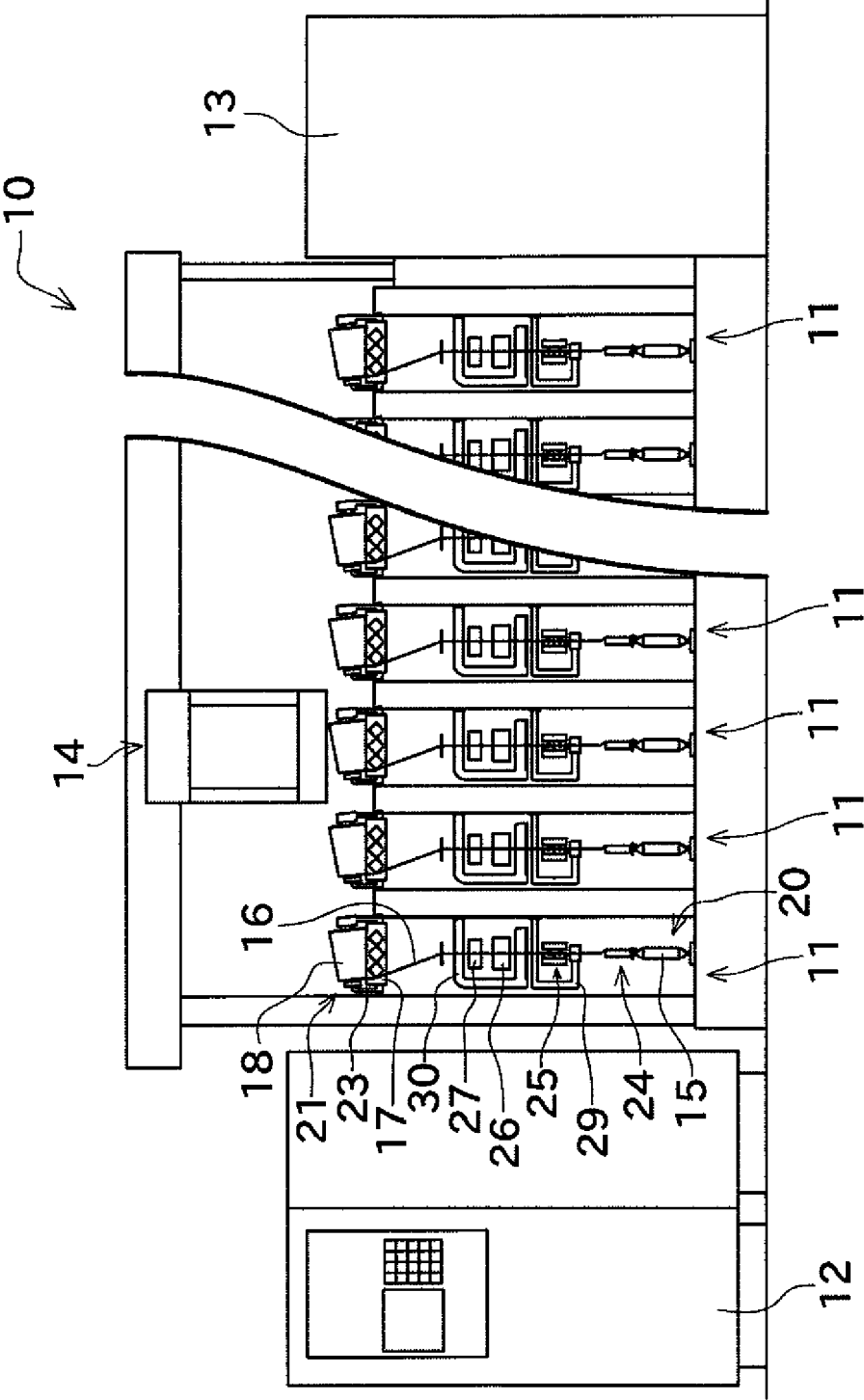


FIG.2

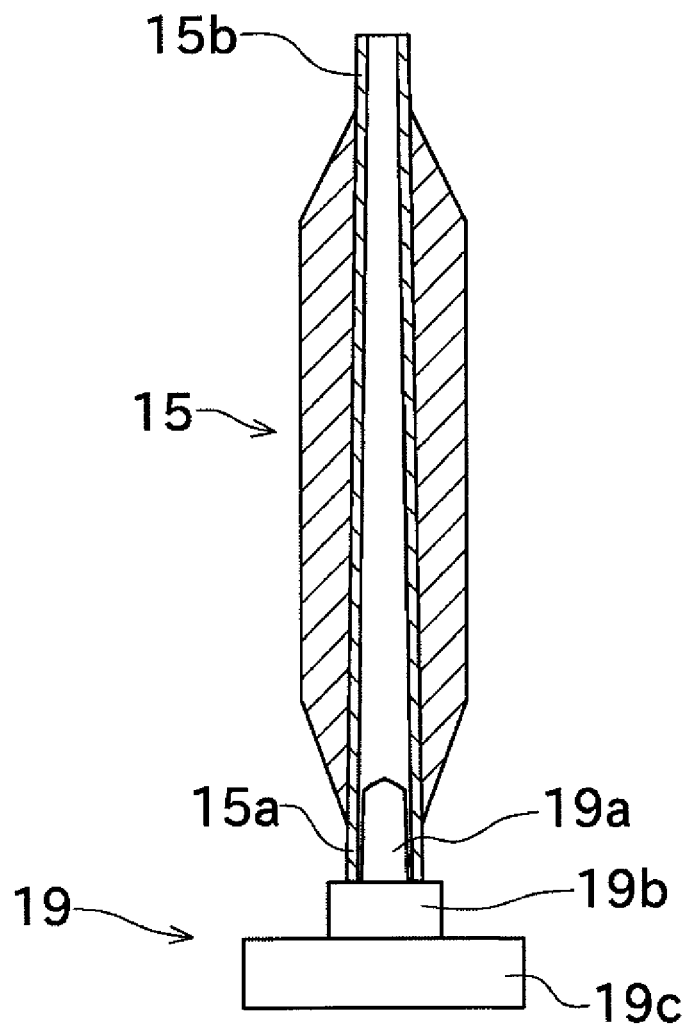


FIG.3

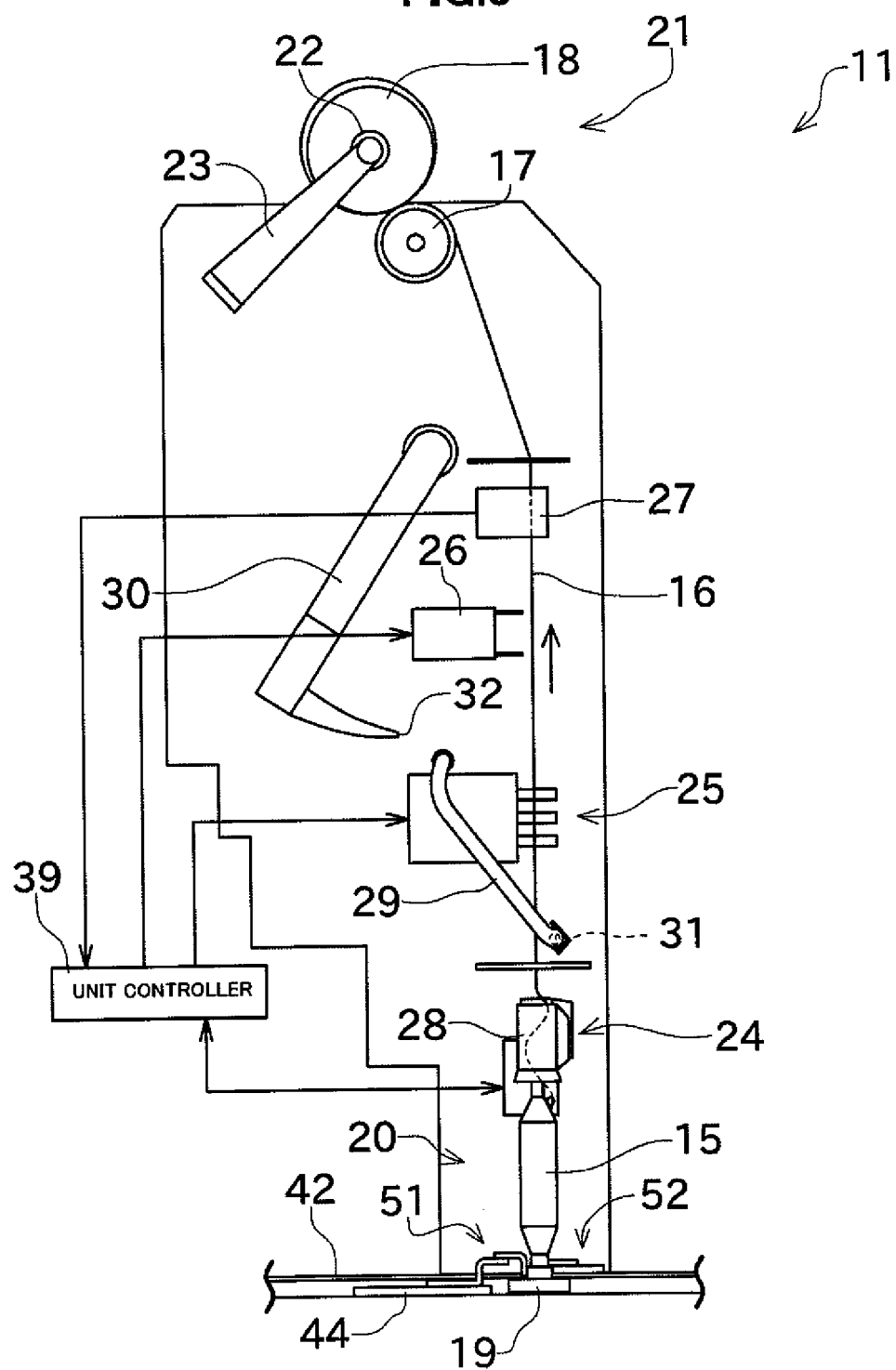


FIG.4

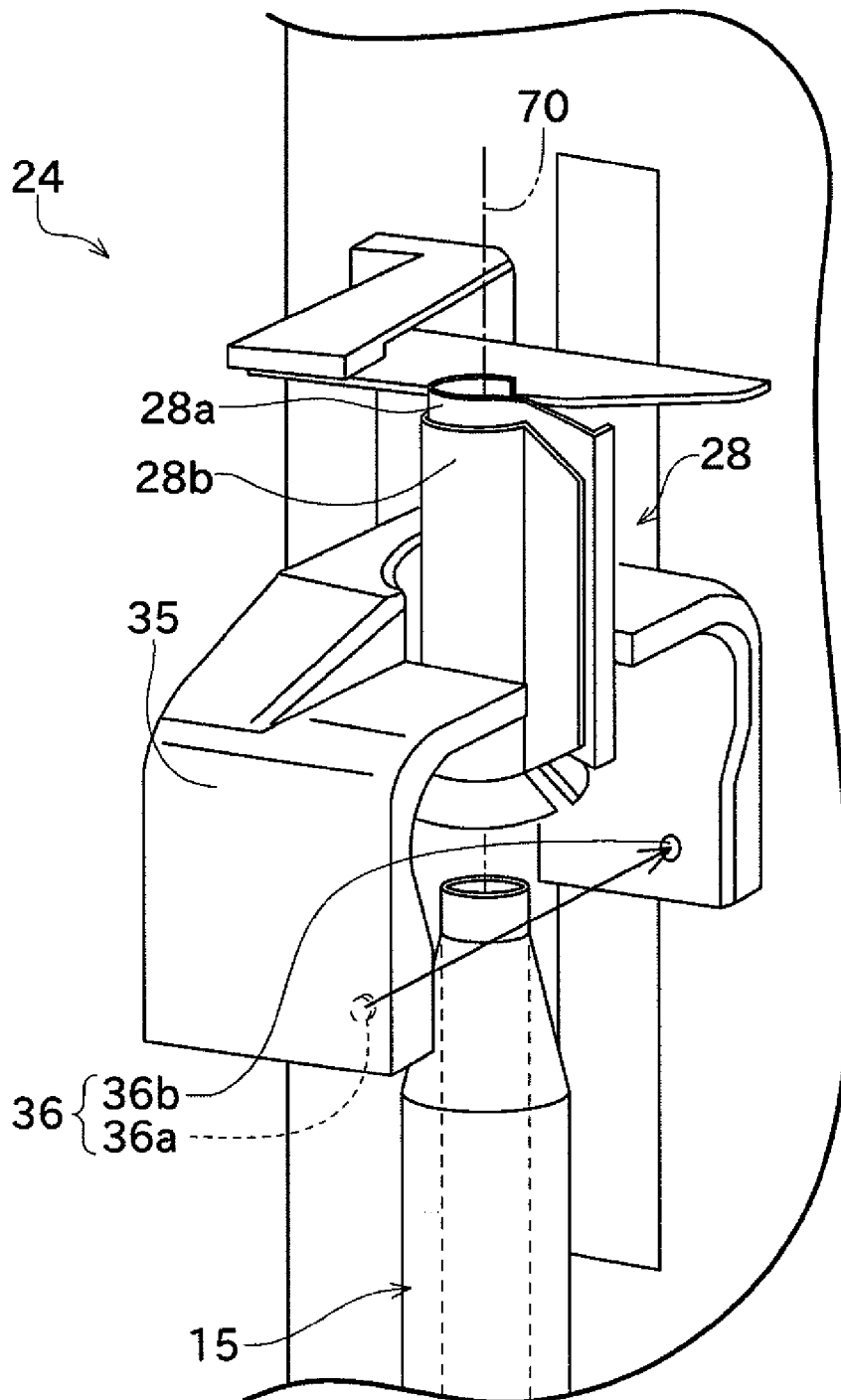


FIG.5

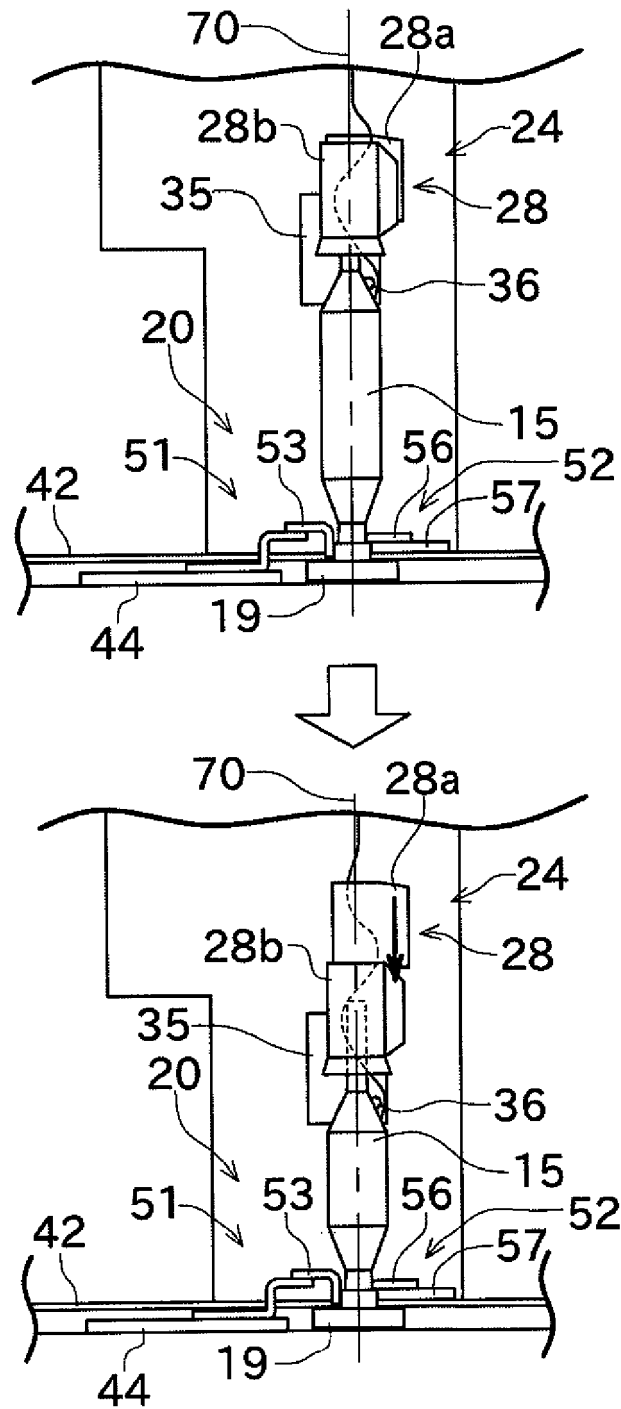


FIG.6

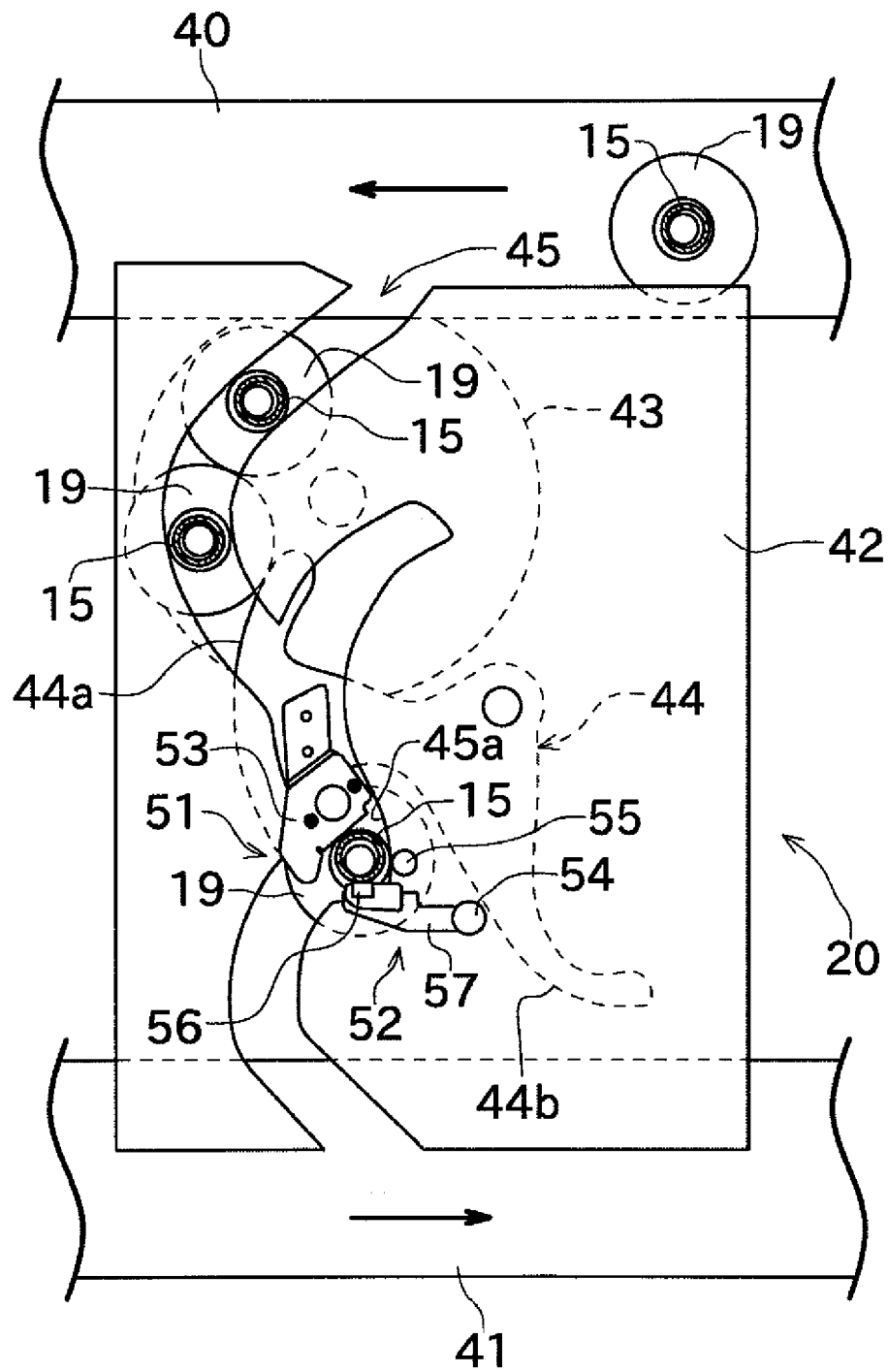


FIG.7

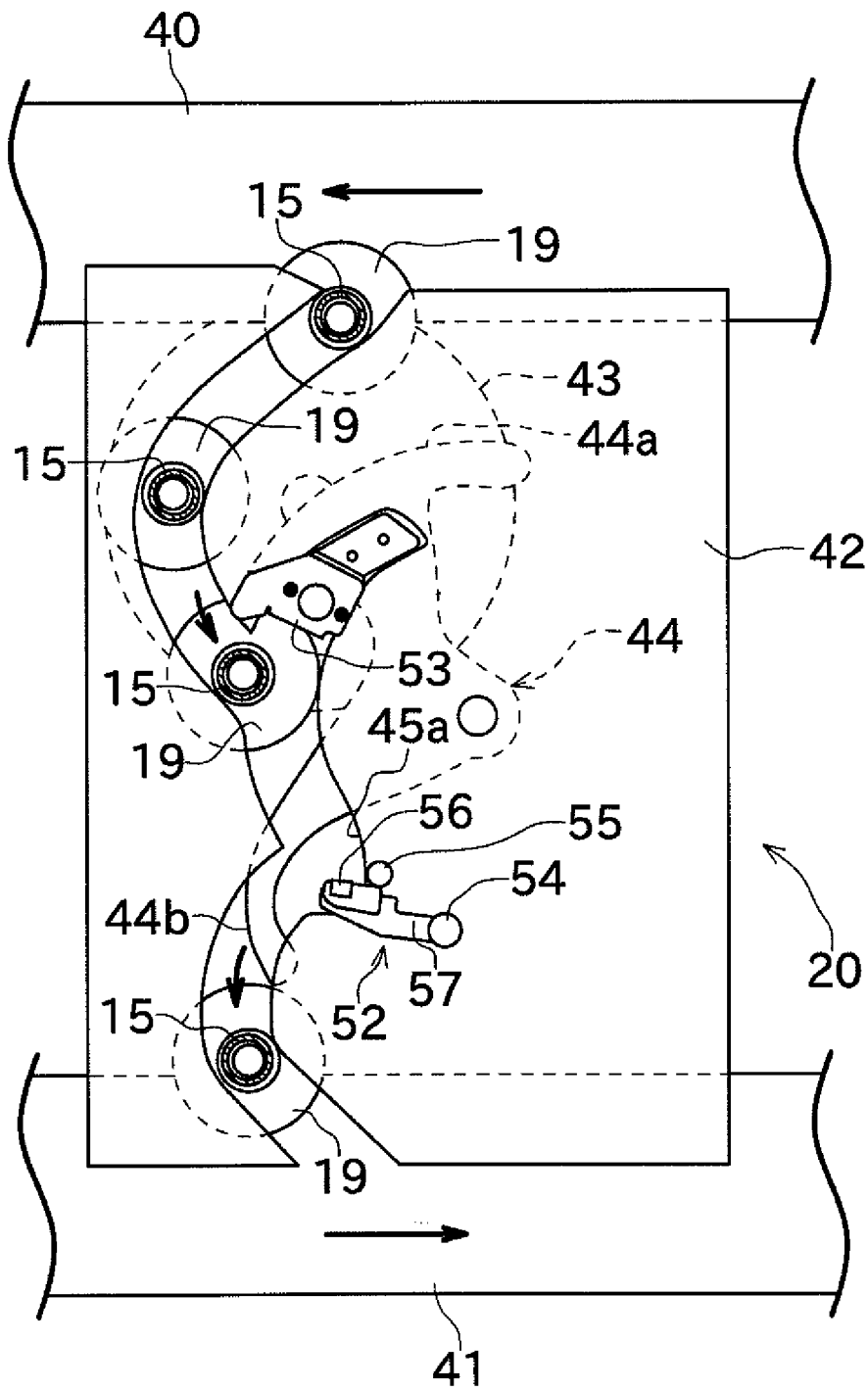
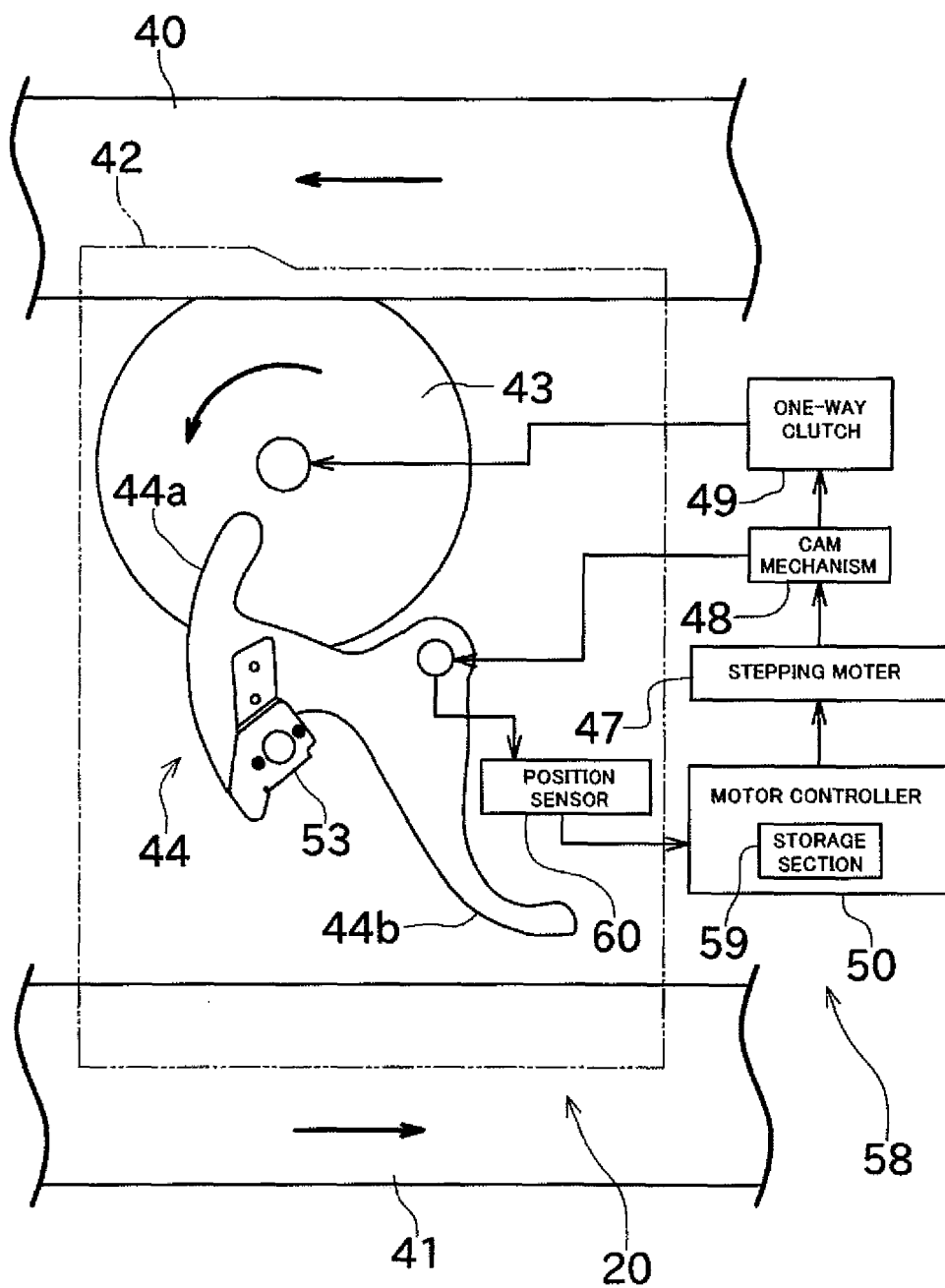


FIG.8



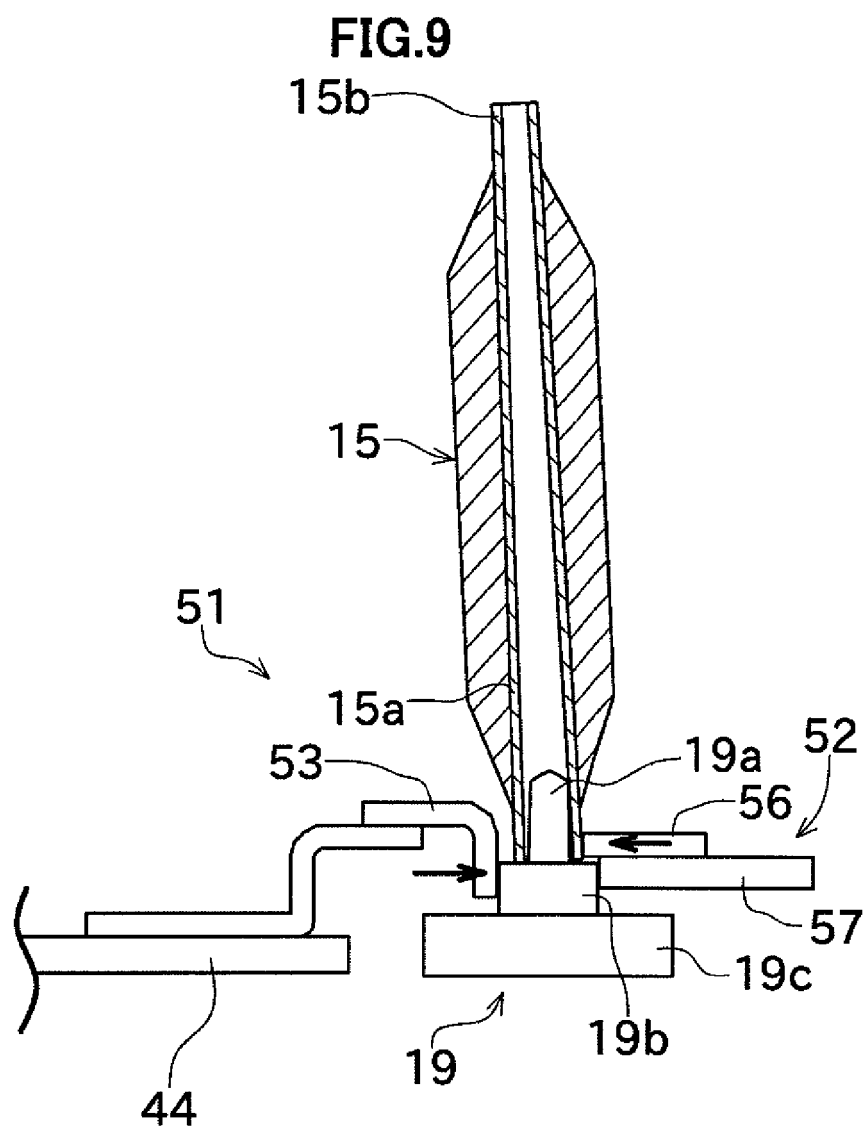


FIG.10

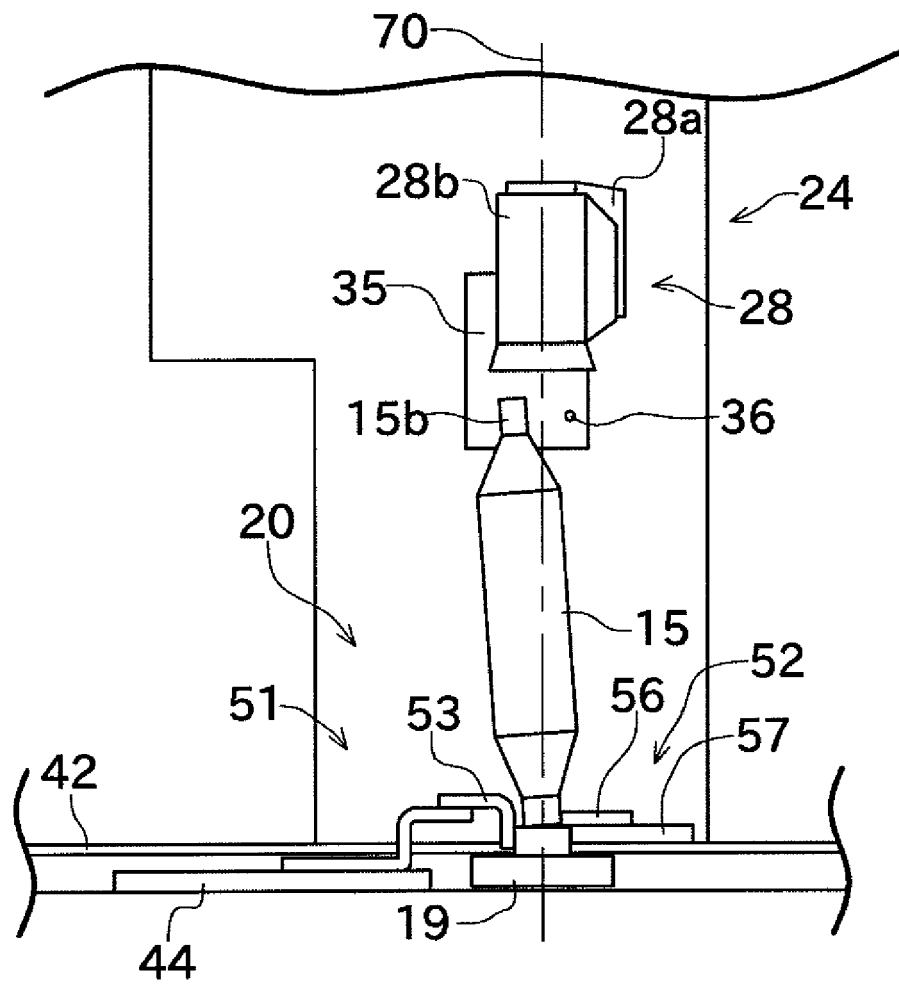


FIG.11

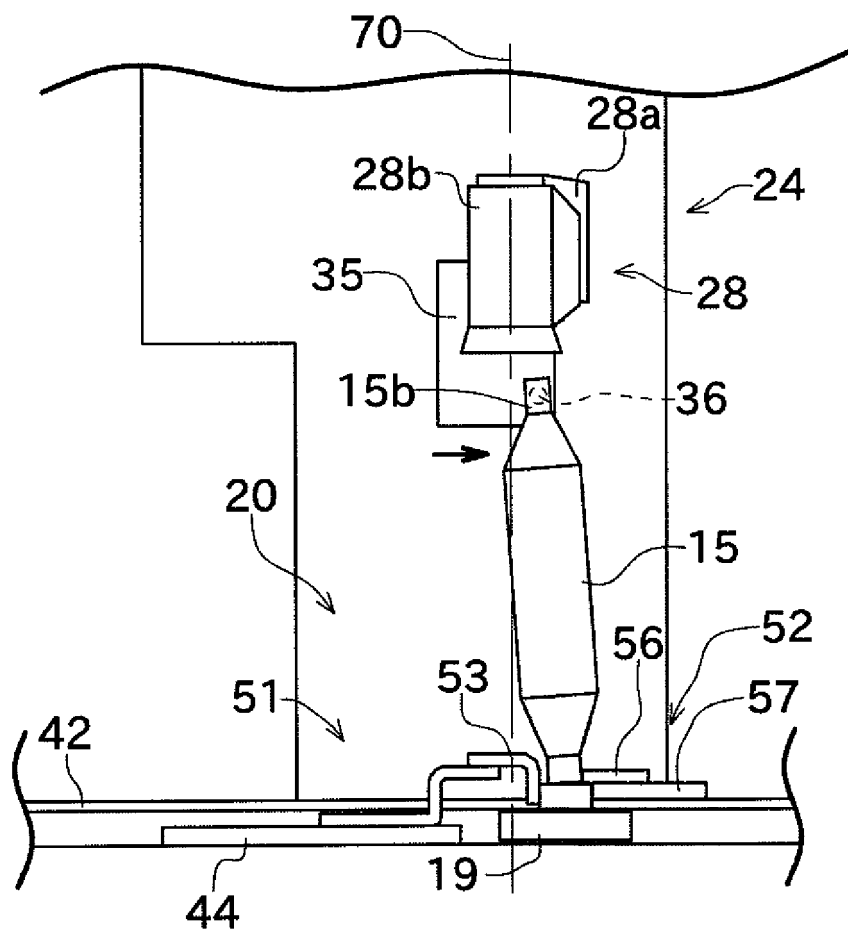


FIG.12

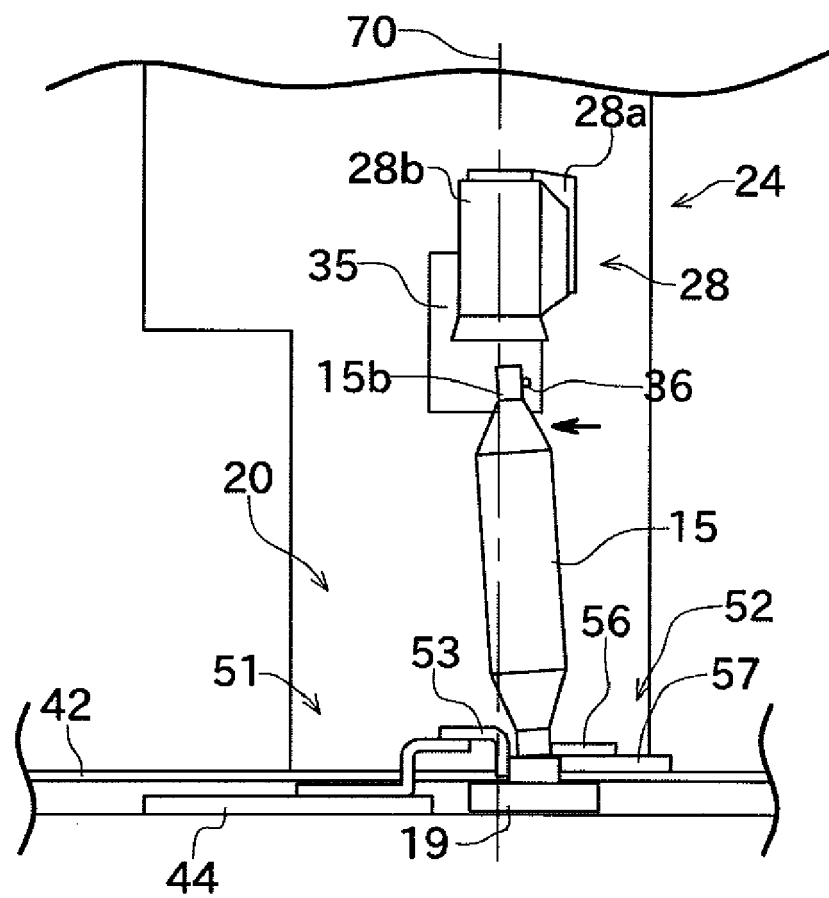


FIG.13

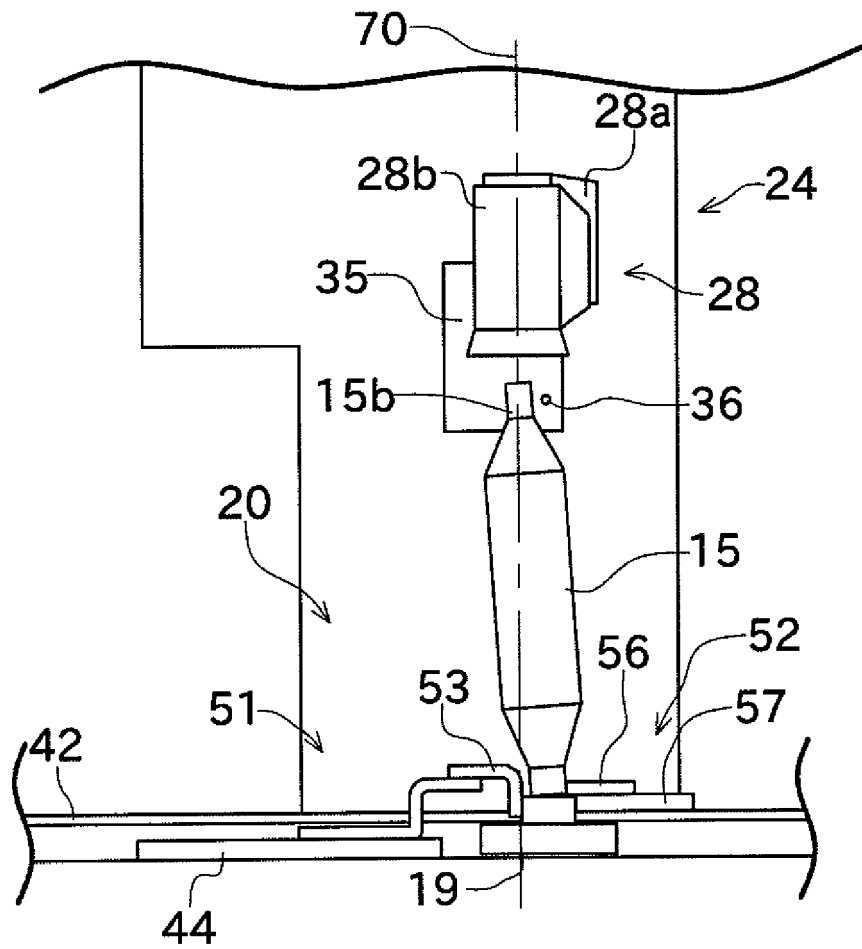
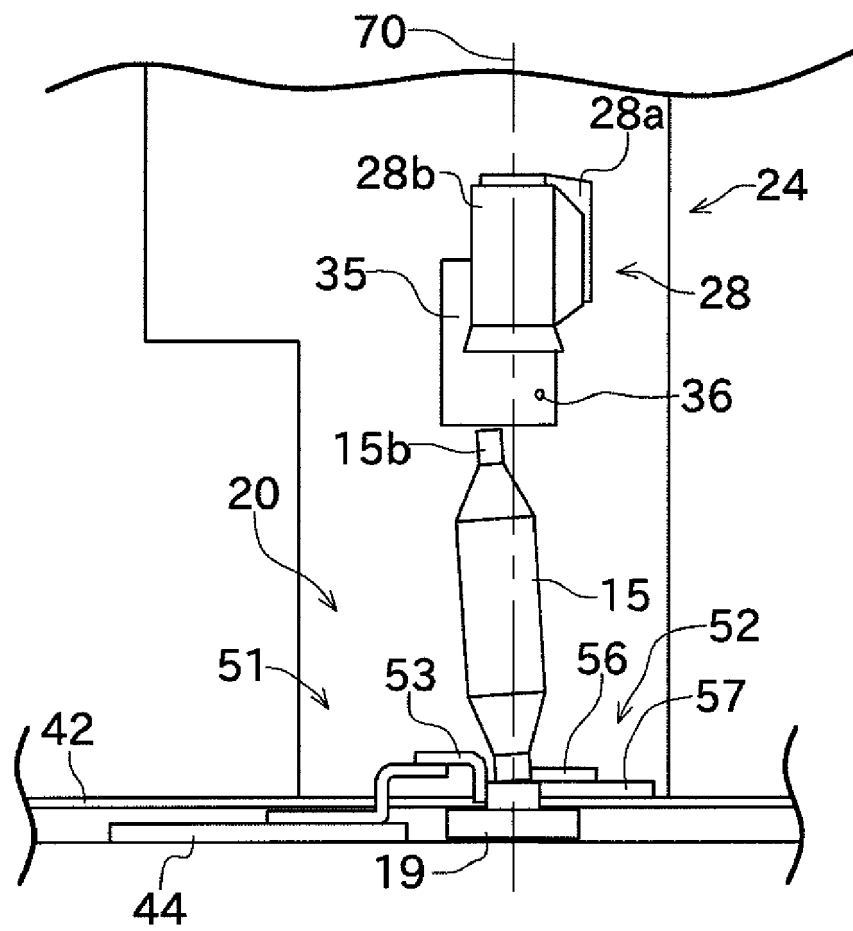


FIG.14



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2009286608 A [0002] [0003] [0004] [0005] [0006]
- JP H665371 B [0008] [0112]