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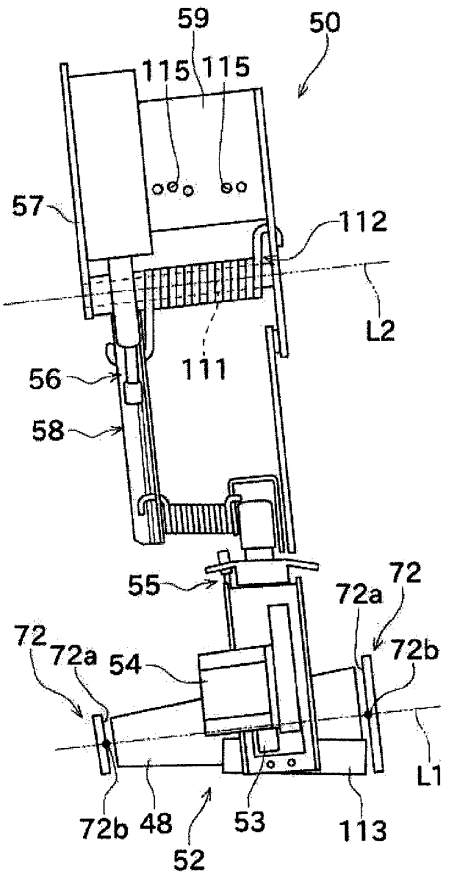
(54) Yarn winding apparatus

(57) A bobbin installation device (60) includes a bobbin gripping section (52) and a path adjusting plate (59). A pivot arm (58) is attached to a rocker shaft (111) and swings by pivoting about the rocker shaft (111). The bobbin gripping section (52) grips a bobbin, onto which a yarn is to be wound, and supplies the bobbin in between a pair of bobbin holders (72) that define a target position of the bobbin. The path adjusting plate (59) can adjust a path (bobbin supplying path) along which the bobbin is supplied by the bobbin gripping section (52) to the target position. Most Illustrative Drawing: FIG. 4

FIG.4



EP 2 441 718 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates generally to a yarn winding apparatus including a bobbin installation device that installs a bobbin, onto which a yarn is to be wound, at a target position.

2. Description of the Related Art

[0002] Bobbin installation devices that, before starting yarn winding by a spinning machine or after a spinning machine has discharged a fully wound package, or in similar situations, supply a bobbin, onto which yarn is not yet wound, to a bobbin holding section of the spinning machine or the like to make preparation (bunch winding or the like) to start a winding operation are known in the art. Examples of a spinning machine known to the inventor that include a bobbin installation device of this type are disclosed in Japanese published unexamined application No. 2005-219880 and Japanese published unexamined application No. H9-100066.

[0003] A doffing cart of a spinning machine disclosed in Japanese published unexamined application No. 2005-219880 includes a chucker (bobbin gripping section) that grips a bobbin. The chucker is caused to pivot toward a cradle (bobbin holding section) when supplying the bobbin to the cradle. The bobbin installed on the cradle is in contact with a rotatable driving drum (winding drum). The bobbin is rotated when the driving drum rotates. A yarn is wound onto the bobbin as the bobbin rotates thereby forming a package.

[0004] A doffing cart of a spinning machine disclosed in Japanese published unexamined application No. H9-100066 includes an arm member that is pivotable about a shaft. A chuck mechanism that holds a bobbin, onto which a yarn is to be wound, is provided on a distal end portion of the arm member. A bobbin is supplied to the cradle by causing the arm member, which is in a state where the chuck mechanism is gripping the bobbin, to pivot.

[0005] The spinning machine disclosed in Japanese published unexamined application No. 2005-219880 forms a cheese-shaped package. When a conical package is to be formed, the spinning machine disclosed in Japanese published unexamined application No. 2005-219880 uses a bobbin installation device having the same layout as that for forming a cheese-shaped package. Accordingly, there is a likelihood of occurrence of a collision between a bobbin being supplied and the cradle. A reason for this is described below with reference to FIG. 5A.

[0006] To perform yarn winding stably while securing a uniform contact between the winding drum and a package, it is desirable to change, for example, an orientation of the cradle used for forming a conical package with reference to an orientation of the cradle used for forming a cheese-shaped package. However, if the orientation of the cradle is changed but the bobbin is supplied to the cradle along a similar path to that for forming a cheese-shaped package, a clearance between a bobbin 48 being supplied and bobbin holders 72, which serve as the bobbin holding section, can sometimes become very small as shown in FIG. 5A, for example. In the example shown in FIG. 5A, while the bobbin 48 is supplied to a position between a pair of the bobbin holders 72, a large-diameter end portion of the bobbin 48 is very close to one of the bobbin holders 72.

[0007] In general, the bobbin holders 72 cannot have a large clearance therebetween because of requirements imposed on a layout of the spinning machine. Accordingly, in a situation where a bobbin installation device of the same layout is used even when forming a package of a different shape, a high positioning accuracy is required in a bobbin supplying operation to avoid the collision between the bobbin and the bobbin holders, thereby increasing cost of the bobbin installation device.

[0008] Meanwhile, a configuration for avoiding the collision described above in the bobbin installation device has not been disclosed either in Japanese published unexamined application No. 2005-219880 or Japanese published unexamined application No. H9-100066. Accordingly, to avoid the collision between the bobbin and the bobbin holders in the conventional bobbin installation device, it is necessary to change a bobbin supplying path by changing the entire bobbin installation device. This disadvantageously creates the need to perform a complicated operation when changing the bobbin installation device or to prepare a plurality of bobbin gripping mechanisms, resulting in an increase in cost or the like.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a yarn winding apparatus including a bobbin installation device adapted to prevent a bobbin being supplied from colliding with a bobbin holding section. This object is achieved by a yarn winding apparatus according to claim 1.

[0010] According to a first aspect of the present invention, a yarn winding apparatus includes a bobbin installation device and a bobbin holding section. The bobbin holding section defines a target position. The bobbin installation device includes a bobbin gripping section and a rocker shaft. The bobbin gripping section performs a bobbin supplying operation by gripping a bobbin, onto which a yarn is to be wound, and supplying the bobbin to the target position. The rocker shaft swings to bring the bobbin gripping section to the target position. To hold the bobbin supplied from the bobbin installation device, the bobbin holding section includes two holding mechanisms that hold the bobbin at two ends of the bobbin in its axial direction. An axis of the rocker shaft is substan-

tially parallel to a line that passes through centers of the holding mechanisms.

[0011] If the holding line is not parallel to the rocker shaft, the bobbin being supplied is likely to collide with the bobbin holding section. However, in the bobbin installation device configured as described above, it is possible to supply the bobbin by effectively utilizing a clearance between the holding mechanisms of the bobbin holding section (without employing a layout in which the clearance is unnecessarily large). Accordingly, the yarn winding apparatus can be made compact.

[0012] The bobbin installation device preferably further includes an adjustment section capable of adjusting a path along which the bobbin is to be supplied by the bobbin gripping section to the target position by adjusting an orientation of the rocker shaft.

[0013] The adjustment section allows the bobbin installation device to perform adjustment such that the bobbin is supplied through an appropriate path depending on the shape of the bobbin to be supplied or the like.

[0014] The adjustment section of the yarn winding apparatus preferably includes a mounting member and a fixture. The mounting member supports the bobbin gripping section. The fixture fixes the mounting member that locks at least a change in an installation orientation.

[0015] The adjustment section configured as described above allows the bobbin installation device to change the installation orientation of the mounting member and fix the mounting member at the changed orientation with the fixture so that the bobbin is supplied through an appropriate path.

[0016] In the bobbin installation device described above, a plurality of selection holes is preferably defined in the mounting member. The fixture is positioned in one of the selection holes to lock at least the change in the installation orientation of the mounting member.

[0017] The bobbin installation device configured as described above can adjust the path along which the bobbin is supplied only by inserting the fixture into one of the selection holes thereby defining the position of the mounting member. The selection hole is selected based on a winding condition and/or the like. The adjustment section can thus have a simple structure. This leads to reduction in the number of components involved in the bobbin installation device.

[0018] In the yarn winding apparatus, the bobbin installation device preferably includes an operating section that operates the bobbin holding section to perform a dismounting operation, which is an operation of dismounting the bobbin from the bobbin holding section.

[0019] In many cases, the doffing operation including dismounting of the package is followed by an operation of supplying a new bobbin to form a new package. In this regard, in the spinning machine configured as described above, both the dismounting operation and the bobbin supplying operation can be performed in one device. Accordingly, the entire spinning machine can be configured compact.

[0020] In the yarn winding apparatus, the bobbin supplying operation performed by the bobbin gripping section and the dismounting operation performed by the operating section are independently operable.

[0021] The yarn winding apparatus configured as described above can perform the doffing operation and the bobbin supplying operation independently. This makes it possible to prevent an unnecessary bobbin supplying operation from being performed in a situation where, for example, it is not necessary to form a new package immediately after one package has been fully wound. Accordingly, working time of the bobbin installation device can be shortened and hence a subsequent operation can be started quickly. This leads to improvement in winding efficiency of the yarn winding apparatus.

[0022] The yarn winding apparatus preferably includes a yarn-catching-and-carrying device that performs a yarn-catching-and-carrying operation, which is an operation of catching a yarn and carrying the yarn to the bobbin that is supplied by the bobbin gripping section to the bobbin holding section. The yarn winding apparatus preferably performs the bobbin supplying operation performed by the bobbin gripping section, the dismounting operation performed by the operating section, and the yarn-catching-and-carrying operation performed by the yarn-catching-and-carrying device independently.

[0023] In the yarn winding apparatus configured as described above, it is possible to skip unnecessary operation(s) depending on a situation that can vary. Accordingly, working time of the bobbin installation device can be shortened and hence a subsequent operation can be started quickly. This leads to improvement in winding efficiency of the yarn winding apparatus.

[0024] The yarn winding apparatus preferably includes a plurality of winding units, each of which includes the bobbin holding section and winds a yarn onto the bobbin held by the bobbin holding section to form a package. A plurality of the winding units is arranged in one direction. The bobbin installation device is movable in the direction in which the winding units are arranged.

[0025] Accordingly, cost reduction can be achieved by reducing the number of the bobbin installation devices provided in the yarn winding apparatus as compared to a configuration in which the bobbin installation devices are provided on a per-winding-unit basis.

[0026] The above and other objects, features, advantages and 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

[0027]

FIG. 1 is a schematic elevation view of an overall structure of a spinning machine according to an em-

bodiment of the present invention;
FIG. 2 is a longitudinal cross-sectional view of the spinning machine shown in FIG. 1;
FIG. 3 is a perspective view of a bobbin supplying section, shown in FIG. 2, when supplying a bobbin;
FIG. 4 is a plan view of the configuration of the bobbin supplying section, shown in FIG. 3, when supplying the bobbin;
FIGS. 5A and 5B are diagrams for explaining a difference between a conventional bobbin supplying path and a bobbin supplying path according to the present embodiment;
FIG. 6 is a longitudinal cross-sectional view of the spinning machine in a state where a spun yarn is caught by a suction pipe shown in FIG. 1 while a doffing operation of a fully wound package is being performed;
FIG. 7 is a longitudinal cross-sectional view of the spinning machine in a state where the suction pipe has moved to a predetermined position and is in a standby state while the spun yarn remains sucked by the suction pipe;
FIG. 8 is a longitudinal cross-sectional view of the spinning machine at an instant at which the bobbin is supplied to a cradle shown in FIG. 2;
FIGS. 9A to 9C are longitudinal cross-sectional views of a structure for moving a cradle operating arm shown in FIG. 1; and
FIGS. 10A to 10C are longitudinal cross-sectional views of a structure for moving the suction pipe.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] Exemplary embodiments of the present invention are described in detail below with reference to the accompanying drawings.

[0029] A spinning machine (yarn winding apparatus) according to an embodiment of the present invention is described below. Note that "upstream" and "downstream" used in this specification are upstream and downstream, respectively, with respect to a running direction of a yarn during spinning. FIG. 1 is a schematic elevation view of an overall structure of a spinning machine 1 according to the embodiment. FIG. 2 is a longitudinal cross-sectional view of the spinning machine 1.

[0030] The spinning machine 1 shown in FIG. 1 includes a plurality of spinning units (winding units) 2 arranged in a line. The spinning machine 1 also includes a splicer carrier 3, a doffer carrier 4, a blower box 93, and a motor box 5.

[0031] As shown in FIG. 1, each of the spinning units 2 includes a drafting device 7, a spinning device 9, a yarn pooling device 12, and a winding device 13, which are arranged from upstream to downstream in this order. The drafting device 7 is provided near a top end of a frame 6 of the spinning machine 1. A fiber bundle 8 fed from the drafting device 7 is spun by the spinning device 9 into a spun yarn 10. The spun yarn 10 from the spinning device 9 passes through a yarn clearer 49, which will be described later, and then passes through the yarn pooling device 12. The winding device 13 winds the spun yarn 10 on a bobbin 48 to form a package 45.

[0032] The drafting device 7 drafts a sliver 15 into the fiber bundle 8. As shown in FIG. 2, the drafting device 7 includes four pairs of rollers, or, more specifically, a pair of back rollers 16, a pair of third rollers 17, a pair of middle rollers 19 around each of which an apron belt 18 is laid, and a pair of front rollers 20.

[0033] Although a detailed structure of the spinning device 9 is not shown, in the present embodiment, an air-jet-spinning-type spinning device is employed as the spinning device 9. More specifically, the spinning device 9 twists the fiber bundle 8 by using a swirling airflow to form the spun yarn 10.

[0034] The yarn pooling device 12 is arranged downstream of the spinning device 9. The yarn pooling device 12 has a function of drawing out the spun yarn 10 from the spinning device 9 while applying a predetermined tension on the spun yarn 10, a function of pooling the spun yarn 10 fed from the spinning device 9 to prevent a slack in the spun yarn 10 during splicing performed by the splicer carrier 3, and a function of adjusting a yarn tension so that variations in the yarn tension on the side of the winding device 13 are not transmitted to the spinning device 9. As shown in FIG. 2, the yarn pooling device 12 includes a yarn pooling roller 21, a yarn hook member 22, an upstream guide 23, and an electric motor 25.

[0035] The yarn hook member 22 is capable of hooking (catching) the spun yarn 10. The yarn hook member 22 rotates in one piece with the yarn pooling roller 21 in a state where the spun yarn 10 is hooked by the yarn hook member 22 so that the spun yarn 10 is carried onto an outer peripheral surface of the yarn pooling roller 21.

[0036] The yarn pooling roller 21 pools the spun yarn 10 by winding the spun yarn 10 on an outer peripheral surface of the yarn pooling roller 21. The yarn pooling roller 21 is rotated at a predetermined rotational speed by the electric motor 25.

[0037] The yarn hook member 22 is rotatably supported relative to the yarn pooling roller 21. On the yarn hook member 22, a torque (resisting torque) against rotation of the yarn hook member 22 relative to the yarn pooling roller 21 is applied by a torque generating section (not shown) implemented as, for example, a magnetic-torque generating section. With this structure, in a situation where the spun yarn 10 is hooked by the yarn hook member 22, if a tension applied to the spun yarn 10 is large enough to overcome the resisting torque, the yarn hook member 22 rotates independently of the yarn pooling roller 21, thereby unwinding the spun yarn 10 from the yarn pooling roller 21. On the contrary, if the tension applied to the spun yarn 10 is weaker than the resisting torque, the yarn hook member 22 rotates in one piece with the yarn pooling roller 21, thereby winding the spun yarn 10 on the yarn pooling roller 21.

[0038] As described above, the yarn pooling device 12 winds the spun yarn 10 when the tension applied to the spun yarn 10 decreases (i.e., when a slack is likely to be given to the spun yarn 10), while the yarn pooling device 12 unwinds the spun yarn 10 when the tension applied to the spun yarn 10 increases. Accordingly, the yarn pooling device 12 is capable of taking up a slack in the spun yarn 10 and applying an appropriate tension on the spun yarn 10.

[0039] As described above, the yarn hook member 22 acts to accommodate variations in the tension applied to the spun yarn 10 between the yarn pooling device 12 and the winding device 13. Accordingly, it is possible to prevent the variations in the tension from influencing the spun yarn 10 between the spinning device 9 and the yarn pooling device 12. Thus, the yarn pooling device 12 can draw out the spun yarn 10 from the spinning device 9 at a relatively steady velocity.

[0040] The upstream guide 23 is arranged at a position slightly upstream with respect to the yarn pooling roller 21. The upstream guide 23 serves as a guide member for an appropriate carriage of the spun yarn 10 to the outer peripheral surface of the yarn pooling roller 21. The upstream guide 23 also serves as a twist preventer that prevents propagation of twisting of the spun yarn 10 to a downstream side beyond the upstream guide 23.

[0041] The yarn clearer 49 is arranged on a front-surface side of the frame 6 of the spinning machine 1 at a position between the spinning device 9 and the yarn pooling device 12. The spun yarn 10 spun by the spinning device 9 passes through the yarn clearer 49 before the spun yarn 10 is wound by the yarn pooling device 12. The yarn clearer 49 monitors the thickness of the running spun yarn 10. Upon detecting a yarn defect of the spun yarn 10, the yarn clearer 49 transmits a yarn-defect detection signal to a unit controller (not shown). The yarn clearer 49 can be configured to detect, in addition to an abnormal thickness of the spun yarn 10, a foreign matter in the spun yarn 10.

[0042] Upon receiving the yarn-defect detection signal from the yarn clearer 49, the unit controller stops driving of the drafting device 7 while causing the winding device 13 to continue driving, thereby cutting the spun yarn 10. The unit controller then stops the drafting device 7, the spinning device 9, and the like. The unit controller transmits a control signal to the splicer carrier 3. Upon receiving the control signal, the splicer carrier 3 travels to a position in front of the corresponding spinning unit 2. Thereafter, the unit controller resumes driving of the spinning device 9 and the like and causes the splicer carrier 3 to perform splicing to resume winding. The yarn pooling device 12 successively pools the spun yarn 10, which is continuously fed from the spinning device 9, on the yarn pooling roller 21 to take up a slack in the spun yarn 10 over a period from when the spinning device 9 resumes spinning until when winding is resumed.

[0043] As shown in FIGS. 1 and 2, the splicer carrier 3 includes a splicer (yarn splicing device) 43, a suction pipe 44, a suction mouth 46, and wheels 42. When yarn breakage or yarn cutting occurs in one of the spinning units 2, the splicer carrier 3 runs on a travel lane 41 fixed to the frame 6 by driving the wheels 42. The splicer carrier 3 then stops in front of the spinning unit 2 where the yarn breakage or yarn cutting has occurred to perform the splicing.

[0044] The suction pipe 44 is vertically pivotable about a shaft. The suction pipe 44 sucks and catches a yarn end (upper yarn) of the spun yarn 10 fed from the spinning device 9, and carries the yarn end to the splicer 43. The suction mouth 46 is vertically pivotable about a shaft. The suction mouth 46 sucks and catches a yarn end (lower yarn) of the spun yarn 10 extending from the package 45, and carries the yarn end to the splicer 43. Although description about a detailed structure of the splicer 43 is omitted, the upper yarn and the lower yarn can be spliced by twisting yarn ends by using a swirling airflow.

[0045] The winding device 13 includes a cradle 70. The cradle 70 includes a support shaft 73, a cradle arm 71 that is pivotable about the support shaft 73, and a pair of bobbin holders (bobbin holding section) 72 capable of holding the bobbin 48 at the ends of the bobbin 48.

[0046] The winding device 13 includes a winding drum 74 and a traverse guide 76, on which the spun yarn 10 can be hooked. The winding drum 74 is driven in contact with either an outer peripheral surface of the bobbin 48 or an outer peripheral surface of the package 45 that is formed by winding the spun yarn 10 on the bobbin 48. The winding device 13 causes an electric motor (not shown) to drive the winding drum 74, thereby rotating the package 45 that is in contact with the winding drum 74. Simultaneously, the winding device 13 causes the traverse guide 76 to reciprocate by using a drive mechanism (not shown). Thus, the winding device 13 winds the spun yarn 10 on the package 45 while causing the spun yarn 10 to traverse.

[0047] A spring (not shown) is coupled to the cradle arm 71. The spring constantly applies an urging force in an upright direction onto the cradle arm 71. Accordingly, as the thickness of the package 45 increases with an increasing amount of the spun yarn 10 wound on the bobbin 48, the cradle arm 71 tilts toward the front-surface side of the device, and hence a position of the axis of the package 45 is moved forward. A driving section (not shown) (e.g., a cylinder) is coupled to the cradle arm 71. It is also possible to perform control according to an instruction fed from the unit controller so as to actively cause the cradle arm 71 to pivot in a direction away from the winding drum 74 and a direction toward the winding drum 74.

[0048] The spinning machine 1 according to the present embodiment can form any one of a cheese-shaped package and a conical package by changing some of the elements constituting the cradle 70. Meanwhile, the same winding drum 74 is used for forming the cheese-shaped package and also for forming the conical package.

[0049] When forming a cheese-shaped package, a bobbin for the cheese-shaped package is supported by the cradle 70 in a manner that an axis of the bobbin is substantially parallel to an axis of the winding drum 74. When forming the package 45 of a conical shape, the bobbin 48 for the conical package is supported by the cradle 70 in a manner that the axis of the bobbin 48 is slightly inclined relative to the axis of the winding drum 74 so that the winding drum 74 is brought into stable contact with a conical outer-peripheral surface of the package 45. Therefore, a position of the bobbin holders 72 for forming a cheese-shaped package differs from a position of the bobbin holders 72 for forming a conical package. Meanwhile, conical packages can have various taper angles. Therefore, the cradle 70 supports the bobbin 48 in an orientation depending on a taper angle of a package to be formed.

[0050] As shown in FIGS. 1 and 2, the doffing cart 4 includes a bobbin installation device 60. The bobbin installation device 60 performs a bobbin installing operation and a doffing operation. The bobbin installing operation is an operation of supplying the bobbin 48 to the cradle 70 to prepare for winding of the spun yarn 10 onto the bobbin 48. The doffing operation is an operation of dismounting the package 45 that is fully wound from the cradle 70. The doffing cart 4 includes wheels 92 at a bottom of the doffing cart 4. Upon receiving an instruction to perform the bobbin installing operation or the doffing operation on one of the spinning units 2, the doffing cart 4 travels on a travel lane 91 formed on the frame 6 to the corresponding spinning unit 2. The doffing cart 4 stops in front of the spinning unit 2 for which the instruction was issued, and then performs any one (or both) of the bobbin installing operation and the doffing operation.

[0051] The bobbin installation device 60 includes, as the elements for performing the bobbin installing operation, a bobbin supplying section 50, a suction pipe (yarn catching-and-carrying device) 88, and a cradle operating arm (operating section) 89.

[0052] The suction pipe 88 has a pivotable and telescopic structure. The suction pipe 88 catches the spun yarn 10 discharged from the spinning device 9 by sucking the spun yarn 10 and carries the spun yarn 10 to the winding device 13. A structure for moving the suction pipe 88 is described later.

[0053] The bobbin supplying section 50 that includes a bobbin gripping section 52 is pivotable about a rocker shaft 111 and is capable of gripping the bobbin 48 with the bobbin gripping section 52. The bobbin supplying section 50, in which the bobbin gripping section 52 grips the bobbin 48, is caused to pivot to supply the bobbin 48 to a position (target position) between the bobbin holders 72 of the cradle 70. The bobbin supplying section 50 includes a bunch winding roller 53 for performing bunch winding. Bunch winding means winding the spun yarn 10 in a straight winding manner around the bobbin 48 to fix the spun yarn 10 onto the bobbin 48 at the start of winding to form a package. A detailed structure of the bobbin supplying section 50 is described later.

[0054] The cradle operating arm 89 can operate the cradle arm 71 such that one of the bobbin holders 72 is moved away from the other bobbin holder 72 (separating operation). Meanwhile, as described above, as the thickness of the package 45 increases with increasing amount of the spun yarn 10 wound on the bobbin 48, the orientation of the cradle arm 71 changes. The position of the cradle operating arm 89 can be changed by using a moving mechanism, which will be described later, or the like. Accordingly, the cradle operating arm 89 can perform the separating operation during each of the doffing operation (see FIG. 6) of dismounting the fully wound package 45 and the bobbin installing operation (see FIG. 7).

[0055] The bobbin installation device 60 includes, as the elements for performing the doffing operation, a guiding section 61 shown in FIG. 2 in addition to the cradle operating arm 89. The guiding section 61 receives the fully wound package 45 from the cradle 70 and put it on a sloping member 81. Accordingly, the fully wound package 45 is carried to a receptacle 82. The guiding section 61 includes, as relevant elements, a guiding plate 69, a bobbin guiding cylinder 62, and a roller member 67. The guiding section 61 is pivotable about a rotary shaft 101.

[0056] The guiding plate 69 includes a plate-like contact member and one or more plate-like restricting members. The contact member is in contact with the outer peripheral surface of the fully wound package 45 received from the cradle 70 while carrying the package 45. The restricting members restrict a movement of the package 45 in its axial direction so that the package 45 does not fall from the contact member.

[0057] The bobbin guiding cylinder 62 applies a force on an acting shaft 104 by extending or shortening a cylinder of the bobbin guiding cylinder 62, thereby causing the guiding plate 69 to pivot about a rotary shaft 103 upward or downward. Thus, the guiding section 61 is capable of adjusting the position of the guiding plate 69 that is carrying the package 45 or stopping an inertial rotation of the package 45 after completion of winding of the spun yarn 10.

[0058] The roller member 67 rolls on the sloping member 81 when the package 45 is carried along the sloping member 81. Accordingly, the guiding section 61 can carry the package 45 smoothly.

[0059] The bobbin supplying section 50 is described below in detail with reference to FIGS. 3 and 4. FIG. 3 is a perspective view of the bobbin supplying section 50 and illustrates a situation where the bobbin supplying section 50 is supplying the bobbin 48 to the cradle 70. FIG. 4 is a plan view of the bobbin supplying section 50 and illustrates a situation where the bobbin supplying section 50 is supplying the bobbin 48.

[0060] As shown in FIGS. 3 and 4, the bobbin supplying section 50 includes, in addition to the bobbin gripping section 52 and the bunch winding roller 53, a fixed arm 57, a path adjusting plate (mounting member) 59, a pivot arm 58, a bobbin supplying cylinder 56, a bunch winding

motor 54, and a gripping-section driving cylinder 55.

[0061] As described above, the bobbin supplying section 50 is pivotable about the rocker shaft 111. A torsion spring 112 is wound around the rocker shaft 111. The torsion spring 112 urges the pivot arm 58 in a direction (in which the bobbin gripping section 52 approaches the doffing cart 4) opposite from a direction in which the pivot arm 58 is pivoted to supply the bobbin 48.

[0062] The bobbin supplying cylinder 56 is a cylinder that can be extended or shortened in response to an instruction issued by the bobbin installation device 60. One end of the bobbin supplying cylinder 56 is attached to a basal end of the fixed arm 57. The pivot arm 58 that is pivotable about the rocker shaft 111 is pivotably attached to the other end of the bobbin supplying cylinder 56.

[0063] Extending the bobbin supplying cylinder 56 configured as described above in a manner to overcome an urging force of the torsion spring 112 causes the pivot arm 58 to pivot about the rocker shaft 111, and hence the bobbin 48 to be supplied to the cradle 70. As shown in FIG. 4, the bobbin holders 72, i.e., a pair of holding mechanisms 72a, hold the bobbin 48 therebetween in an axial direction of the bobbin 48. In the discussion below, a straight line that connects holding centers 72b, which are the centers of the holding mechanisms 72a, is referred to as a holding line L1. The holding line L1 is, put another way, a rotation axis of the bobbin 48 when the bobbin 48 is arranged between the bobbin holders 72. A straight line passing through the center of the rocker shaft 111 in the longitudinal direction is referred to as a pivot axis L2.

[0064] The bobbin supplying section 50 includes an adjustment section that includes the path adjusting plate 59 and a fixture. By inserting the fixture, such as a bolt, into one of selection holes 115 defined in the path adjusting plate 59, the bobbin supplying section 50 is fixed onto an appropriate member of the doffing cart 4. The selection holes 115, which can be formed in an appropriate number, for example, five in the present embodiment, are defined in the path adjusting plate 59. The position and the orientation of the path adjusting plate 59 (accordingly, the position and the orientation of the rocker shaft 111) can be adjusted as desired by inserting the fixture in an appropriate selection hole 115. In the present embodiment, as illustrated in FIG. 4, the orientation of the rocker shaft 111 is adjusted in such a manner that the holding line L1 becomes substantially parallel to the pivot axis L2.

[0065] A path of movement of a distal end of the pivot arm 58 is changed to a desired path by adjusting the position and the orientation of the rocker shaft 111 as described above. Thus, the bobbin installation device 60 can change the path of the bobbin 48, along which the bobbin 48 is supplied to the bobbin holder 72. In the discussion below, this path is referred to as a "bobbin supplying path" in some cases.

[0066] The bunch winding motor 54 generates a driving force for rotating the bunch winding roller 53. This driving force is transmitted through a transmission mechanism (not shown) (e.g., a belt and a pulley) to the bunch winding roller 53.

[0067] Meanwhile, to perform the bunch winding, it is necessary to bring the bunch winding roller 53 into contact with the bobbin 48. For this reason, the bobbin supplying section 50 includes a moving mechanism (more specifically, the gripping-section driving cylinder 55, which will be described later) that moves the bunch winding roller 53 so that it comes into contact with the bobbin 48.

[0068] As shown in FIG. 3, the bobbin gripping section 52 includes a fixed gripping member 113 and a movable gripping member 114. The movable gripping member 114 is coupled to the gripping-section driving cylinder 55. The movable gripping member 114 is moved toward or away from the fixed gripping member 113 by an action of the gripping-section driving cylinder 55. The bobbin gripping section 52 can grip or ungrip the bobbin 48 in this way.

[0069] In the present embodiment, switching between a state where the bunch winding roller 53 is in contact with the bobbin 48 and a state where the bunch winding roller 53 is away from the bobbin 48 can be performed by using the gripping-section driving cylinder 55. The action of the bobbin gripping section 52 is linked to the action of the bunch winding roller 53. More specifically, when the bobbin 48 is gripped by the bobbin gripping section 52, simultaneously the bunch winding roller 53 is separated from the bobbin 48. When the bobbin 48 is ungripped by the bobbin gripping section 52, simultaneously the bunch winding roller 53 is brought into contact with the bobbin 48.

[0070] A conventional bobbin supplying path and the bobbin supplying path according to the present embodiment are described below based on comparison therebetween with reference to FIGS. 5A and 5B. FIGS. 5A and 5B are diagrams for explaining the differences between the conventional bobbin supplying path and the bobbin supplying path according to the present embodiment.

[0071] As described earlier in the discussion related to the conventional technology, collision was likely to occur between the bobbin 48 being supplied and the bobbin holder 72 (see FIG. 5A). However, the bobbin supplying section 50 according to the present embodiment performs adjustment whereby the holding line L1 is substantially parallel to the pivot axis L2 as illustrated in FIG. 5B. Accordingly, parallelism between a central axis of the bobbin 48 and the holding line L1 can be maintained during the course where the bobbin 48 is being supplied. The bobbin supplying section 50 can supply the bobbin 48 along a circular path that lies along a plane orthogonal to the holding line L1.

[0072] Thus, the bobbin supplying section 50 is capable of supplying the bobbin 48 to a position between the bobbin holders 72 in a manner that the bobbin 48 is inserted in a relatively straight orientation and favorably

fitted at the position. Accordingly, it is possible to effectively utilize the space, on which a limitation in terms of size is generally imposed, between the bobbin holders 72 to thereby avoid collision between the bobbin 48 being supplied and the bobbin holder 72. In the spinning machine 1, it is difficult to have a relatively large space between adjacent ones of the spinning units 2 because a large number of the spinning units 2 are installed in a limited installation space.

[0073] As described above, the spinning machine 1 according to the present embodiment can form, by changing some of the elements constituting the cradle 70, any one of a cheese-shaped package and conical packages of different types that differ from one another in taper angle. Put another way, the positions of the bobbin holders 72 and accordingly the orientation of the holding line L1 are changed depending on the shape of the package to be formed. In the bobbin installation device 60 according to the present embodiment, it is possible to position the pivot axis L2 substantially parallel to the holding line L1 irrespective of the shape of the package to be formed by attaching the path adjusting plate 59 by using a corresponding one of the selection holes 115. Accordingly, the bobbin installation device 60 can supply the bobbin 48 to the cradle 70 smoothly in various situations and hence can be used for a wide variety of general purposes.

[0074] A sequence of the doffing operation and a sequence of the bobbin installing operation performed by the bobbin installation device 60 are described below with reference to FIGS. 6 to 8. The doffing operation is described first with reference to FIG. 6. FIG. 6 is a longitudinal cross-sectional view of the spinning machine in a state where the spun yarn 10 is caught by the suction pipe 88 while the doffing operation of the fully wound package 45 is being performed.

[0075] When it is detected by a sensor (not shown) that the package 45 of one of the spinning units 2 is fully wound, the unit controller causes the corresponding spinning device 9 to stop, and simultaneously commands the doffing cart 4 to travel to the corresponding spinning unit 2. Substantially concurrently therewith, the unit controller performs control operations to cause the cradle arm 71 of the corresponding winding device 13 to pivot leftward of FIG. 2 (toward a front-surface side of the spinning unit 2), thereby separating the fully wound package 45 from the corresponding winding drum 74, and to stop rotation of the package 45.

[0076] Even after the package 45 is separated from the winding drum 74, the package 45 continues the inertial rotation. The bobbin installation device 60 extends the bobbin guiding cylinder 62 of the guiding section 61, thereby causing the guiding plate 69 to pivot upward to come into contact with the package 45. As a result, the inertial rotation of the package 45 is stopped.

[0077] Until the inertial rotation of the package 45 is stopped completely, the bobbin installation device 60 moves the cradle operating arm 89 to a position shown in FIG. 6. When the inertial rotation of the package 45 is stopped completely, the bobbin installation device 60 causes the cradle operating arm 89 to move the cradle arm 71 in a manner that one of the bobbin holders 72 moves away from the other bobbin holder 72, thereby dismounting the fully wound package 45 from the cradle 70.

[0078] The dismounted fully wound package 45 is conveyed to the sloping member 81 while the weight of the package 45 is supported by the guiding plate 69 (more specifically, the contact member) of the guiding section 61. The guiding section 61 causes the package 45 to roll down the sloping member 81 to thereby move the package 45 while remaining in the state of contacting the package 45. Meanwhile, at this time, the roller member 67 of the guiding section 61 rolls on the sloping member 81. Thereafter, the package 45 is carried to the receptacle 82.

[0079] In the present embodiment, the receptacle 82 functions as a conveyer. The receptacle 82 conveys the package 45 in the direction, in which the spinning units 2 are arranged, to thereby automatically deliver the package 45 to a subsequent process. Alternatively, a configuration can be employed in which the receptacle 82 does not function as a conveyer and the package 45 on the receptacle 82 is manually collected by an operator. The doffing operation is performed as described above.

[0080] The bobbin installing operation is described below with reference to FIGS. 6 to 8. FIG. 7 is a longitudinal cross-sectional view of the spinning unit 2 in a state where the suction pipe 88 has moved to a predetermined position and is in a standby state with the spun yarn 10 remaining sucked by the suction pipe 88. FIG. 8 is a longitudinal cross-sectional view of the spinning unit 2 at an instant at which the bobbin 48 is supplied to the cradle 70.

[0081] When the doffing cart 4 reaches a position in front of the corresponding spinning units 2 as commanded, the unit controller of the spinning unit 2 causes the drafting device 7 and the spinning device 9 to resume driving. Substantially simultaneously therewith, the suction pipe 88 is extended upward (see FIG. 6). The suction pipe 88 catches the spun yarn 10 by sucking a yarn end of the spun yarn 10 discharged from the spinning device 9.

[0082] The bobbin installation device 60 moves the suction pipe 88 downward with the spun yarn 10 remaining sucked by the suction pipe 88. At this time, the unit controller performs control operations so that the spun yarn 10 sucked by the suction pipe 88 is wound around the yarn pooling device 12. Meanwhile, a suction force of the suction pipe 88 is relatively small and does not overcome the resisting torque of the yarn pooling device 12. Accordingly, as shown in FIG. 7, the spun yarn 10 is pooled on the yarn pooling device 12.

[0083] After the suction pipe 88 has been moved downward, the bobbin installation device 60 leaves the suction pipe 88 in the standby state at the predetermined position (see FIG. 6). When the suction pipe 88 is moved as described above, substantially simultaneously, the bobbin

installation device 60 moves the cradle operating arm 89 to a position where the cradle operating arm 89 can operate the cradle 70. Before the bobbin 48 is supplied, the bobbin installation device 60 operates the cradle arm 71 in advance to move one of the bobbin holders 72 away from the other bobbin holder 72.

[0084] Subsequently, the bobbin installation device 60 grips the bobbin 48 stocked in an upper portion of the doffing cart 4 with the bobbin supplying section 50 (the bobbin gripping section 52). Thereafter, the bobbin installation device 60 extends the bobbin supplying cylinder 56, thereby causing the pivot arm 58 to pivot. Thus, the bobbin installation device 60 causes the bobbin supplying section 50 to advance from the side of the doffing cart 4, thereby supplying the bobbin 48 to the cradle 70. The bobbin installation device 60 actuates an appropriate yarn guiding mechanism (not shown) of the bobbin supplying section 50, thereby placing the spun yarn 10 caught by the suction pipe 88 at a position between an axial end portion of the bobbin 48 and one of the bobbin holders 72. In this state, the cradle operating arm 89 operates the cradle arm 71 such that one of the bobbin holders 72 approaches the other bobbin holder 72. As a result, the spun yarn 10 is fixed by being pinched between the end portion of the bobbin 48 and the bobbin holder 72.

[0085] Subsequently, the bobbin installation device 60 performs the bunch winding by actuating the gripping-section driving cylinder 55 to cause the bobbin gripping section 52 to ungrip the bobbin 48 and bringing the bunch winding roller 53 into contact with the bobbin 48. Meanwhile, the structure of the bobbin installation device 60 can be simplified because, as described above, the action of the bobbin gripping section 52 is linked with the action of the bunch winding roller 53.

[0086] When the bunch winding is completed, the bobbin supplying cylinder 56 is shortened, causing the bobbin supplying section 50 to retreat to the side of the doffing cart 4. Substantially concurrently therewith, the unit controller causes the cradle 70 to pivot so as to bring the bobbin 48 into contact with the winding drum 74 (i.e., toward a back-surface side of the spinning unit 2). As a result, a winding tension is applied on the spun yarn 10, causing the spun yarn 10 to be gradually unwound from the yarn pooling roller 21 and the winding device 13 to start winding to form the package 45.

[0087] Subsequently, a structure for moving the cradle operating arm 89 and the suction pipe 88 as described above is explained below. The structure related to the cradle operating arm 89 is explained first with reference to FIGS. 9A to 9C. FIGS. 9A to 9C are longitudinal cross-sectional views for explaining the structure for moving the cradle operating arm 89.

[0088] As shown in FIGS. 9A to 9C, the bobbin installation device 60 includes a driving mechanism 30 for changing the position of the cradle operating arm 89. The drive mechanism 30 includes a first driving cylinder 31 and a second driving cylinder 32 that are extended or shortened in response to a change in pressure of air supplied to the cylinders. The drive mechanism 30 includes a first link member 36, a second link member 37, and a third link member 38 that are coupled into one piece.

[0089] FIG. 9A illustrates a state where the cradle operating arm 89 is at a standby position. When the first drive cylinder 31 is extended from the state shown in FIG. 9A to cause the first link member 36 to rotate, the third link member 38, which is coupled to the first link member 36 via the second link member 37, is rotated. As a result, the distal end of the cradle operating arm 89 supported by the third link member 38 is brought to a lower position (see FIG. 9B). The cradle operating arm 89 at the position shown in FIG. 9B can operate the cradle arm 71 that receives the bobbin 48 as shown in FIG. 7.

[0090] When the second drive cylinder 32 is extended from the state shown in FIG. 9B to cause the cradle operating arm 89 to rotate relative to the third link member 38, the distal end of the cradle operating arm 89 is brought to a further lower position (see FIG. 9C). The cradle operating arm 89 at the position shown in FIG. 9C can, when the package 45 is fully wound, dismount the package 45 from the cradle arm 71 as shown in FIG. 6.

[0091] The structure for changing the position of the suction pipe 88 is described below with reference to FIGS. 10A to 10C. FIGS. 10A to 10C are longitudinal cross-sectional views of the structure for moving the suction pipe 88.

[0092] As shown in FIGS. 10A to 10C, the bobbin installation device 60 includes, as elements for changing the position of the cradle operating arm 89, a coupling arm 123 and a suction cylinder 124 that is extended or shortened in response to a change in pressure of air supplied to the suction cylinder 124.

[0093] The coupling arm 123 is pivotably supported on the doffing cart 4 via a pivot point 121 that is arranged at an appropriate position on the doffing cart 4. A drive mechanism (not shown) including, for example, a motor and a cam, that drives the coupling arm 123 is coupled to the coupling arm 123. The suction cylinder 124 and the suction pipe 88 are pivotably coupled to a leading end of the coupling arm 123 via a pivot point 122.

[0094] The suction pipe 88 is extendable because the suction pipe 88 has, for example, a telescopic structure. The suction cylinder 124 is connected to a leading end of the suction pipe 88. The suction pipe 88 can be extended or shortened by changing the pressure of air supplied to the suction cylinder 124.

[0095] FIG. 10A illustrates the suction pipe 88 at a standby position. By extending the suction cylinder 124 while causing the coupling arm 123 to pivot toward the winding device 13, the suction pipe 88 can be moved to a position where the suction pipe 88 can catch the spun yarn 10 discharged from the spinning device 9 (see FIGS. 10B and 6). By causing the cradle operating arm 89 and the suction cylinder 124 to pivot about the pivot point 122 from this state, the spun yarn 10 caught by the suction pipe 88 can be carried downward (see FIGS. 10C and 7).

[0096] Meanwhile, the drive mechanism 30 of the cra-

dle operating arm 89 can operate the cradle operating arm 89 singly by actuating the first drive cylinder 31 and the second drive cylinder 32. Similarly, with regard to the suction pipe 88, the suction pipe 88 can be moved singly (without causing other members to move) to a desired position by actuating the drive mechanism and the suction cylinder 124.

[0097] As described above, with the configuration according to the present embodiment, it is possible to move the bobbin supplying section 50, the cradle operating arm 89, and the suction pipe 88 that have conventionally been linked with one another, separately (independently). Accordingly, in a situation where, for example, it is desired to dismount the package 45 that is fully wound, but it is not necessary to supply the bobbin 48, which is a new one, it is possible to move only the cradle operating arm 89 while leaving the bobbin supplying section 50 and the suction pipe 88 in a stopped state. As a result, the bobbin installation device 60 can skip unnecessary operation(s), thereby achieving reduction in cycle time.

[0098] As described above, the bobbin installation device 60 according to the present embodiment includes the bobbin gripping section 52 and the path adjusting plate 59. The bobbin gripping section 52 grips the bobbin 48, onto which the spun yarn 10 is to be wound, and supplies the bobbin 48 to the bobbin holders 72 serving as the target position (more specifically, the position between the bobbin holders 72). The path adjusting plate 59 can adjust the path (bobbin supplying path), along which the bobbin 48 is supplied by the bobbin gripping section 52 to the bobbin holders 72.

[0099] Accordingly, the bobbin installation device 60 can perform adjustment such that the bobbin 48 is supplied through an appropriate path depending on the shape of the bobbin 48 to be supplied or the like. This adjustment prevents the bobbin 48 from colliding with the bobbin holder 72 when the bobbin 48 is supplied by the bobbin installation device 60 to the bobbin holders 72.

[0100] In the bobbin installation device 60 according to the present embodiment, the adjustment section includes the path adjusting plate 59 and the fixture. The path adjusting plate 59 supports the bobbin gripping section 52. The fixture locks at least a change in an installation orientation of the path adjusting plate 59.

[0101] Accordingly, by changing the installation orientation of the path adjusting plate 59 and fixing the path adjusting plate 59 in the changed orientation, the bobbin installation device 60 can perform the adjustment to cause the bobbin 48 to be supplied through an appropriate path.

[0102] In the bobbin installation device 60 according to the present embodiment, a plurality of the selection holes 115 is defined in the path adjusting plate 59. The fixture is positioned in one of the selection holes 115 to lock at least the change in the installation orientation of the path adjusting plate 59.

[0103] The bobbin installation device 60 configured as described above is capable of adjusting the path, along which the bobbin 48 is to be supplied, only by inserting the fixture into one of the selection holes 115, which is selected based on a winding condition and/or the like, to fix the path adjusting plate 59. The adjustment section that adjusts the bobbin supplying path can thus have a simple structure. This leads to reduction in the number of components involved in the bobbin installation device 60.

[0104] The spinning machine 1 according to the present embodiment includes the bobbin installation device 60 and the spinning units 2. Each of the spinning units 2 includes a pair of the bobbin holders 72 that hold the bobbin 48 supplied from the bobbin installation device 60.

[0105] Accordingly, in the spinning machine 1, collision between the bobbin 48 and the bobbin holder 72 can be prevented by adjusting the path, along which the bobbin 48 is to be supplied.

[0106] In the spinning machine 1 according to the present embodiment, the bobbin holders 72 include the holding mechanisms 72a that hold the bobbin 48 at the two ends in the axial direction of the bobbin 48. When the line extending through the holding centers 72b, which are the centers of the holding mechanisms 72a, is referred to as the holding line L1, the path adjusting plate 59 can adjust the orientation of the rocker shaft 111 so as to make the pivot axis L2 of the rocker shaft 111 substantially parallel to the holding line L1.

[0107] If the holding line L1 is not parallel to the rocker shaft 111, the bobbin 48 being supplied is likely to collide with the bobbin holder 72. However, the bobbin installation device 60 configured as described above can smoothly supply the bobbin 48 to the bobbin holders 72 without employing a layout, in which a clearance between the holding mechanisms 72a of the bobbin holders 72 is unnecessarily large. Therefore, the spinning machine 1 can be configured compact.

[0108] In the spinning machine 1 according to the present embodiment, the bobbin installation device 60 includes the cradle operating arm 89 that operates the cradle 70 to dismount the bobbin 48 from the bobbin holders 72 of the cradle 70.

[0109] The doffing operation, such as dismounting of the package 45, is in many cases followed by the operation of supplying the bobbin 48, which is a new one, to form the package 45, which is a new one. In the spinning machine 1 configured as described above, both of the dismounting operation and the bobbin supplying operation can be performed in one bobbin installation device 60. Accordingly, the spinning machine 1 can be configured compact as a whole.

[0110] The spinning machine 1 according to the present embodiment can perform the operation of supplying the bobbin 48, which is performed by the bobbin supplying section 50, and the operation of dismounting the package 45, which is performed by the cradle operating arm 89, independently.

[0111] Accordingly, the doffing operation and the op-

eration of supplying the bobbin 48 can be performed independently. This makes it possible to prevent an unnecessary operation of supplying the new bobbin 48 from being performed in a situation where, for example, it is not necessary to form the package 45, which is a new one, immediately after one of the packages 45 has been fully wound. Accordingly, working time of the bobbin installation device 60 can be shortened. Furthermore, the doffing cart 4 can travel to another one of the spinning units 2 to start a subsequent operation quickly. This leads to improvement in efficiency in winding of the spun yarn 10 by the spinning machine 1.

[0112] The spinning machine 1 according to the present embodiment includes the suction pipe 88 that catches and carries the spun yarn 10 to the bobbin 48 that is supplied to the bobbin holders 72 by the bobbin gripping section 52. The spinning machine 1 can perform the operation of supplying the bobbin 48, which is performed by the bobbin gripping section 52, the operation of dismounting the package 45, which is performed by the cradle operating arm 89, and the yarn-catching-and-carrying operation, which is performed by the suction pipe 88, independently.

[0113] In the spinning machine 1 configured as described above, unnecessary operation(s) can be skipped depending on a situation that can vary. Accordingly, working time of the bobbin installation device 60 can shortened and a subsequent operation can be started quickly. This leads to improvement in efficiency in winding of the spun yarn 10 by the spinning machine 1.

[0114] In the spinning machine 1 according to the present embodiment, the spinning units 2 are arranged in one direction. The bobbin installation device 60 can travel in the direction in which the spinning units 2 are arranged.

[0115] Such a structure allows reduction in the number of the bobbin installation devices 60 that need to be provided as compared to a structure in which the bobbin installation devices 60 are provided on a per-spinning-unit-2 basis, thereby achieving cost reduction.

[0116] Although the preferred embodiments of the present invention are described above, the structures discussed above can be modified as described below, for example.

[0117] The structure of the spinning machine 1 can be modified appropriately according to a situation. For example, the structure can be modified to a structure in which a yarn feeding device including a pair of rollers is provided in lieu of the yarn pooling device 12 of the spinning machine 1 according to the embodiments or in addition to the yarn pooling device 12 downstream of the spinning device 9.

[0118] The scope of application of the present invention is not limited to spinning machines. The present invention is applicable to any yarn winding apparatus, other than a spinning machine, so long as the yarn winding apparatus supplies a bobbin and winds a yarn onto the bobbin.

[0119] In the embodiment described above, when a yarn defect is detected or when a like situation occurs, the spun yarn 10 is cut by stopping the drafting device 7 with the winding device 13 continuing driving. However, a structure in which a cutter is provided near the yarn clearer 49 and the cutter cuts the spun yarn 10 can alternatively be employed.

[0120] The spinning machine 1 according to the embodiment described above has the structure, in which the fixture, such as a bolt, is inserted into an appropriate one of the selection holes 115 defined in the path adjusting plate 59 to thereby fix the bobbin supplying section 50 onto the doffing cart 4. In lieu of this structure, the spinning machine 1 can have a structure, in which a projection is formed on a surface of the spinning machine 1 where the path adjusting plate 59 is provided, and the projection is inserted into one of the selection holes and the path adjusting plate 59 is fixed with a nut or the like. The structure of the adjustment section is not limited to that described above, and can have any structure that can adjust at least the installation orientation (the bobbin supplying path) of the path adjusting plate 59. In lieu of the structure, in which the adjustment section adjusts the position and the orientation of the rocker shaft 111, a structure, in which the adjustment section can adjust only the orientation, can alternatively be employed.

[0121] In the embodiment described above, moving the guiding section 61 away from the bobbin holders 72 and moving the bobbin supplying section 50 toward the bobbin holders 72 are performed concurrently and simultaneously. Alternatively, the bobbin installing operation can be performed after completion of the doffing operation. However, from a viewpoint of operation efficiency of the spinning machine 1, the doffing operation and the bobbin installing operation are desirably performed concurrently and simultaneously.

[0122] 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 yarn winding apparatus comprising:

a bobbin installation device (60) that includes
a bobbin gripping section (52) adapted to perform a bobbin supplying operation by gripping a bobbin (48), onto which a yarn (10) is to be wound, and supplying the bobbin (48) to a target position; and
a rocker shaft (111) adapted to swing to bring the bobbin gripping section (52) to the target position; and

a bobbin holding section (72) that includes two holding mechanisms (72a) adapted to hold the bobbin (48) at two ends in an axial direction of the bobbin (48) to thereby hold the bobbin (48) supplied from the bobbin installation device (60), the bobbin holding section (72) adapted to define the target position of the bobbin (48), **characterized in that**
an axis (L2) of the rocker shaft (111) is substantially parallel to a line (L1) passing through centers of the holding mechanism (72a).

2. The yarn winding apparatus according to Claim 1, wherein the bobbin installation device (60) further includes an adjustment section adapted to adjust a path along which the bobbin (48) is to be supplied by the bobbin gripping section (52) to the target position by adjusting an orientation of the rocker shaft (111).

3. The yarn winding apparatus according to Claim 2, wherein the adjustment section includes
a mounting member (59) adapted to support the bobbin gripping section (52); and
a fixture adapted to lock at least a change in an installation orientation of the mounting member (59).

4. The yarn winding apparatus according to Claim 3, wherein a plurality of selection holes (115) is defined in the mounting member (59), and
the fixture is positioned in one of the selection holes (115) to lock at least the change in the installation orientation of the mounting member (59).

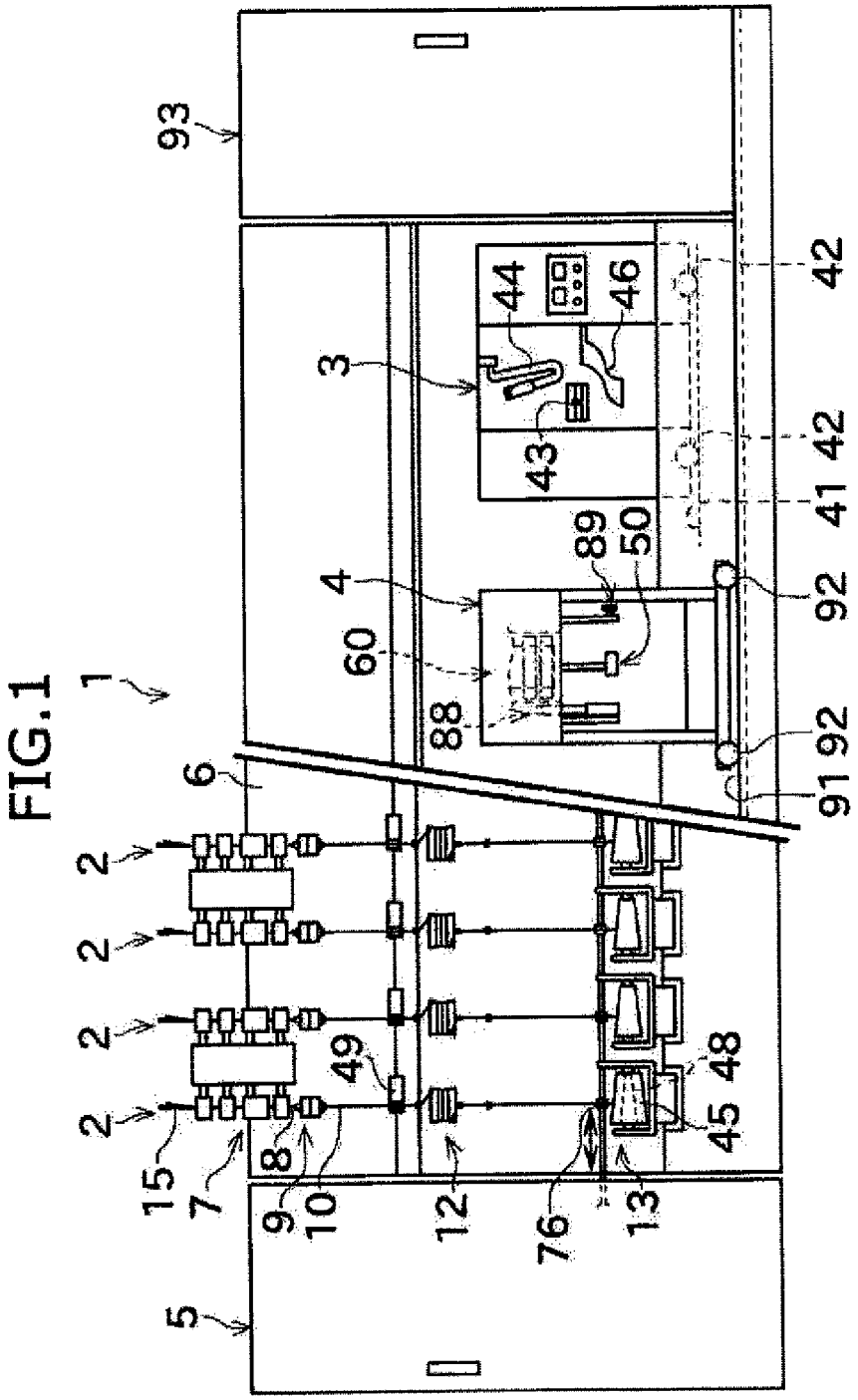
5. The yarn winding apparatus according to any one of Claims 1 to 4, wherein the bobbin installation device (60) includes an operating section (89) adapted to operate the bobbin holding section (72) to perform a dismounting operation, the dismounting operation being an operation of dismounting the bobbin (48) from the bobbin holding section (72).

6. The yarn winding apparatus according to Claim 5, wherein the bobbin supplying operation performed by the bobbin gripping section (52) and the dismounting operation performed by the operating section are independently operable.

7. The yarn winding apparatus according to Claim 5, further comprising a yarn-catching-and-carrying device (88) adapted to perform a yarn-catching-and-carrying operation, the yarn-catching-and-carrying operation being an operation of catching a yarn (10) and carrying the yarn (10) to the bobbin (48) supplied by the bobbin gripping section (52) to the bobbin holding section (72), wherein
the bobbin supplying operation performed by the bobbin gripping section (52), the dismounting operation performed by the operating section, and the yarn-catching-and-carrying operation performed by the yarn-catching-and-carrying device (88) are independently operable.

8. A spinning machine with a yarn winding apparatus according to any one of Claims 1 to 7, further comprising a plurality of winding units (2), each of the winding units (2) including the bobbin holding section (72) and winding a yarn (10) onto the bobbin (48) held by the bobbin holding section (72) to form a package (45), wherein
the winding units (2) are arranged in one direction, and
the bobbin installation device (60) is movable in the direction in which the winding units (2) are arranged.

FIG.1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5

FIG.2

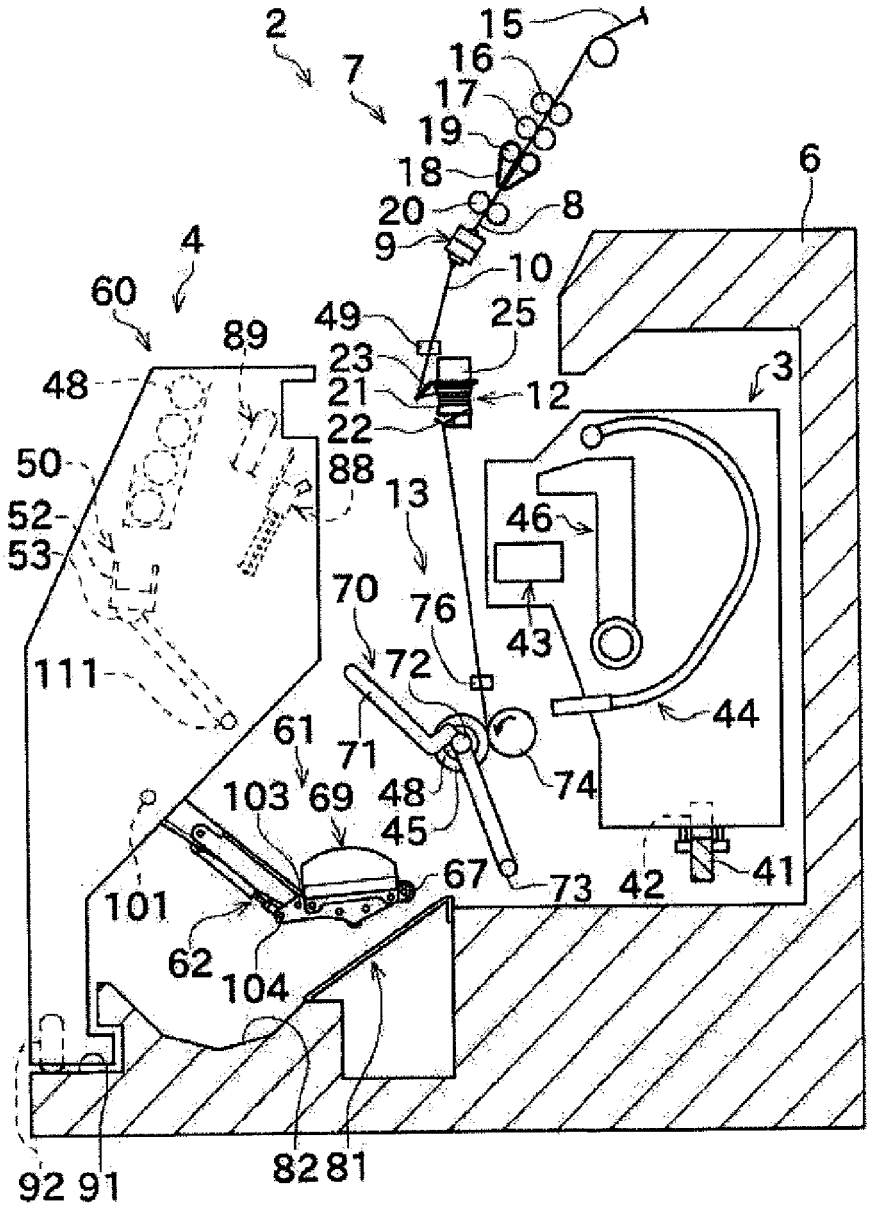
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FIG.3

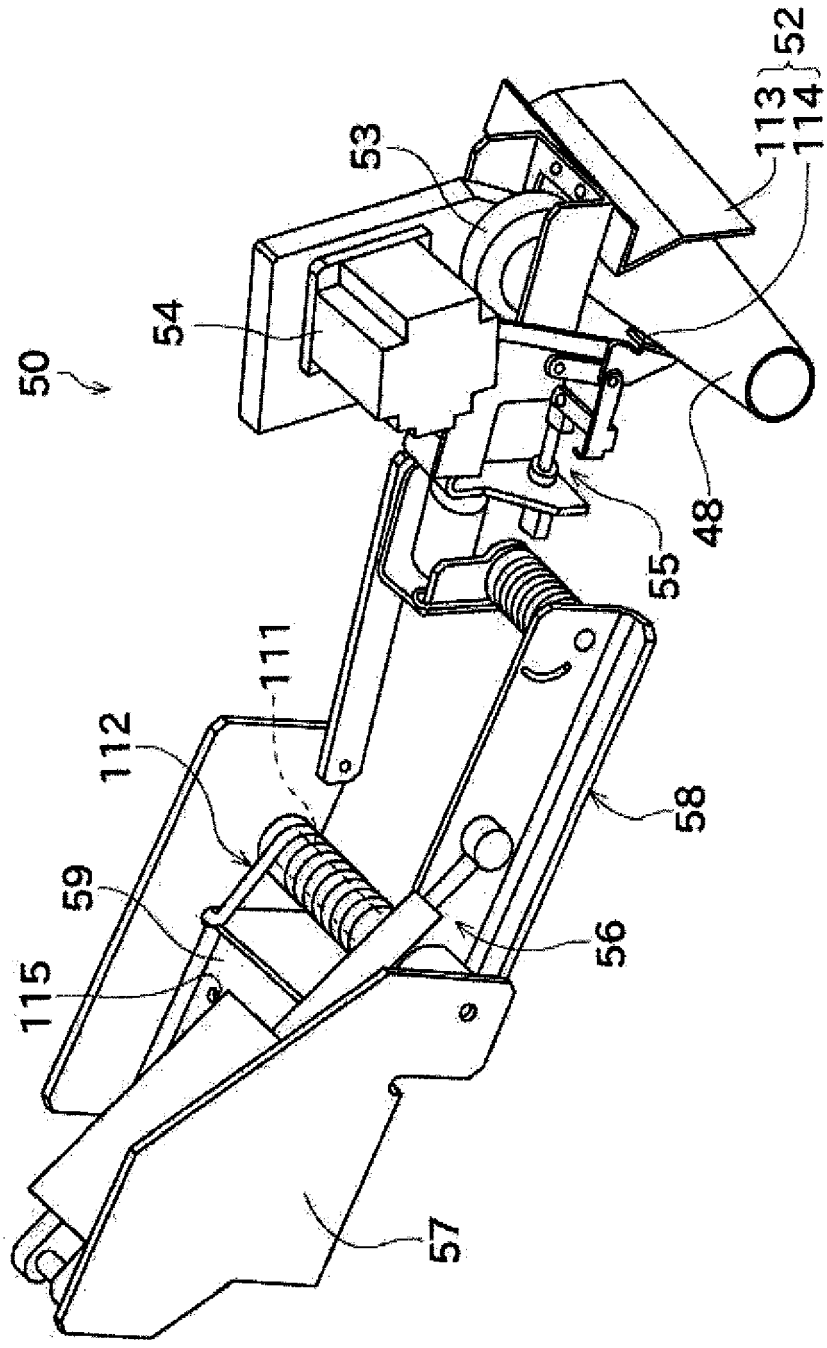
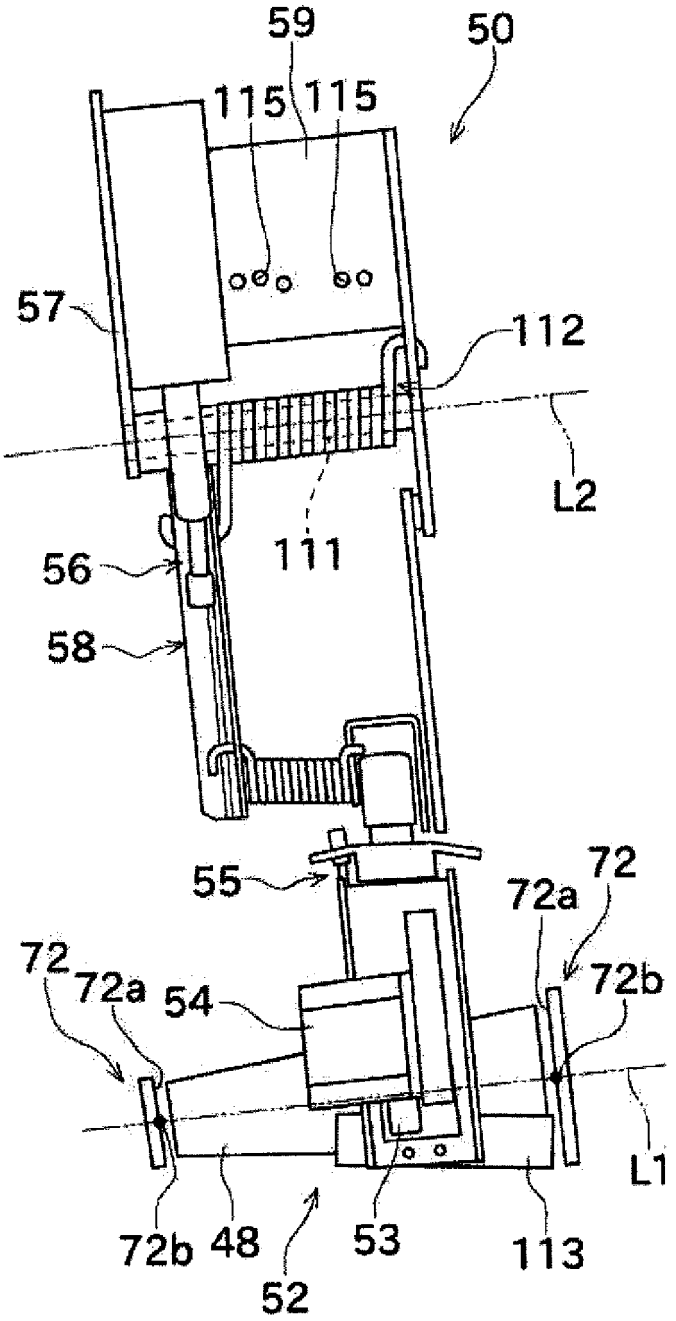


FIG.4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50
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115
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L2
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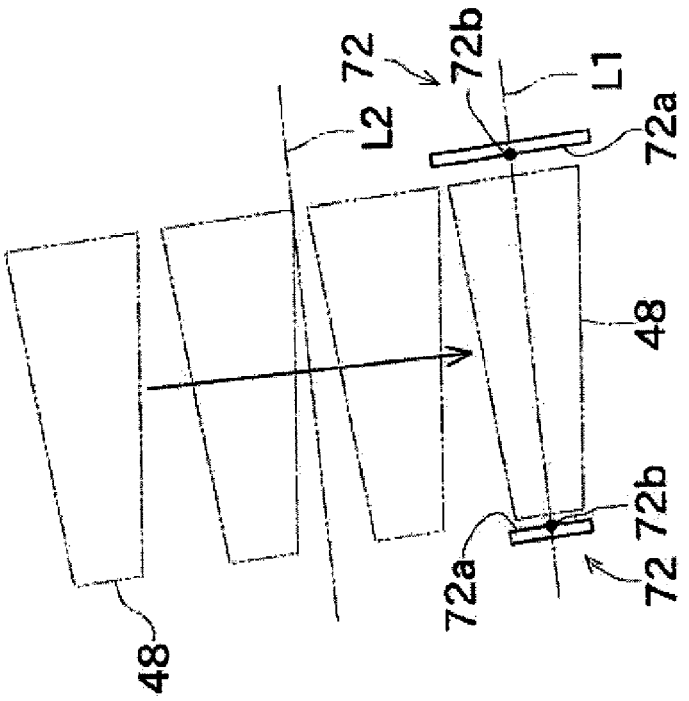
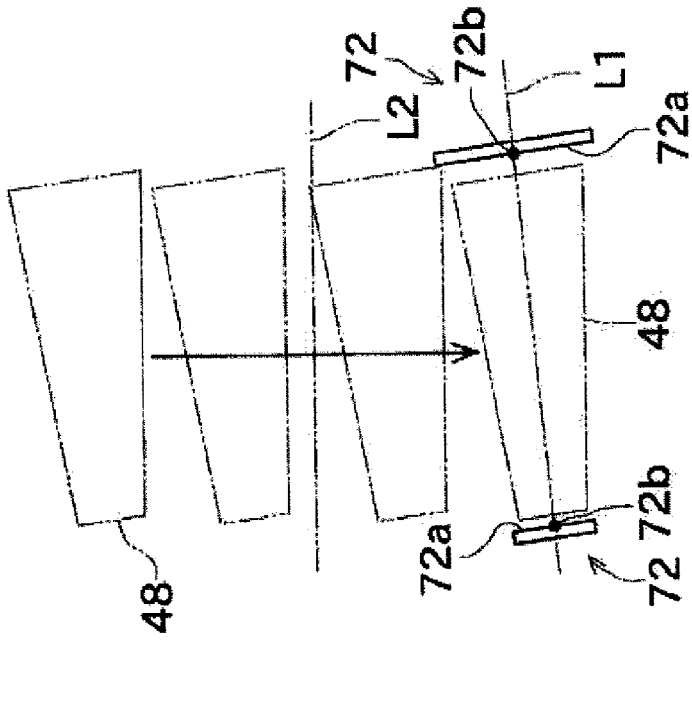
FIG.5B



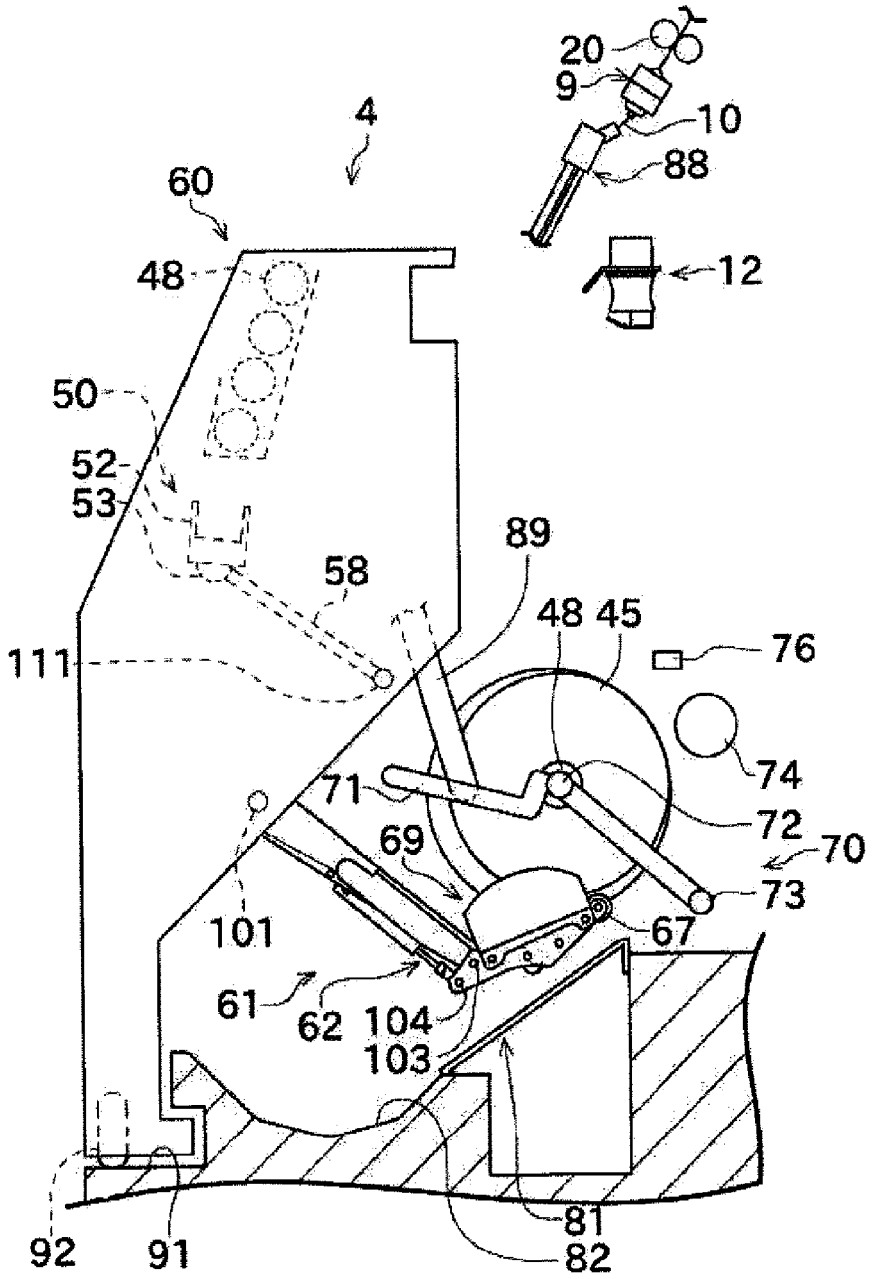
BOBBIN SUPPLY PATH ACCORDING TO PRESENT EMBODIMENT

FIG.5A



CONVENTIONAL BOBBIN SUPPLY PATH

FIG.6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48
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52
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48 45
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FIG.7

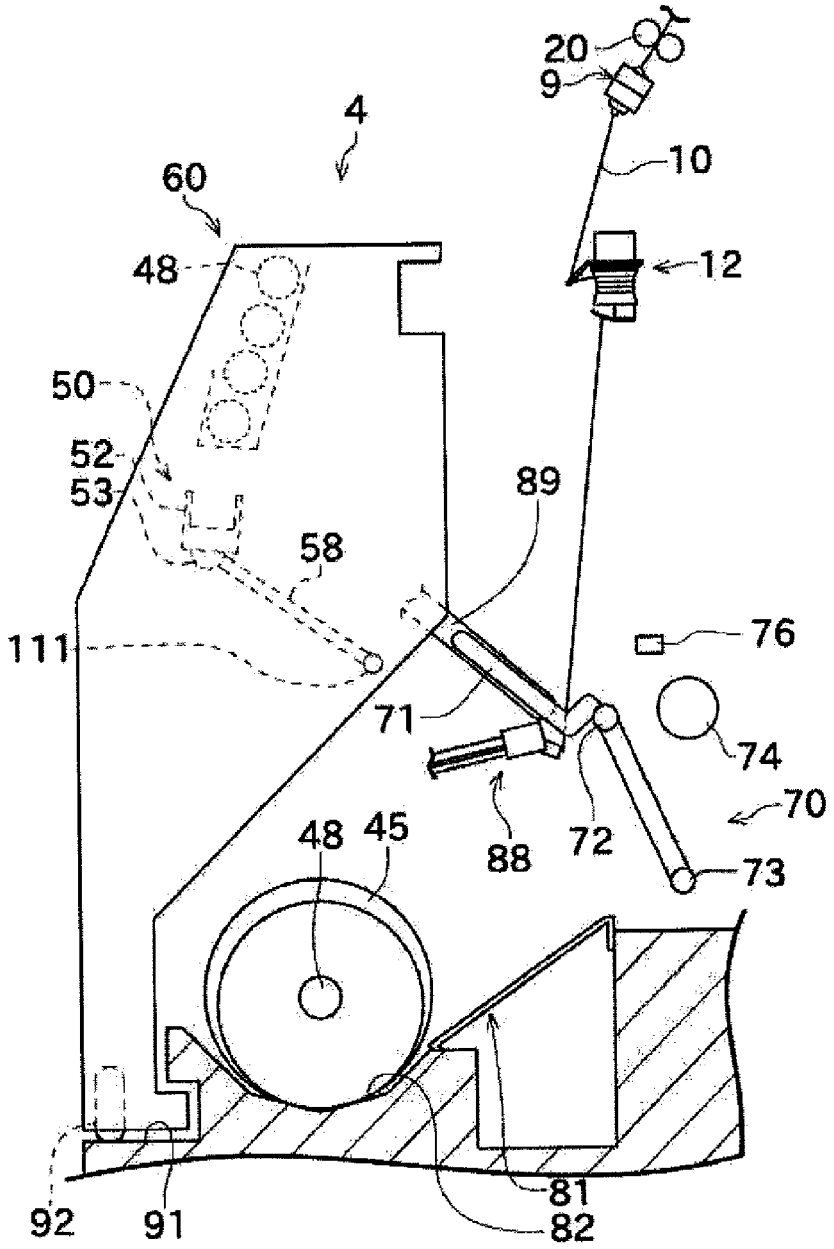
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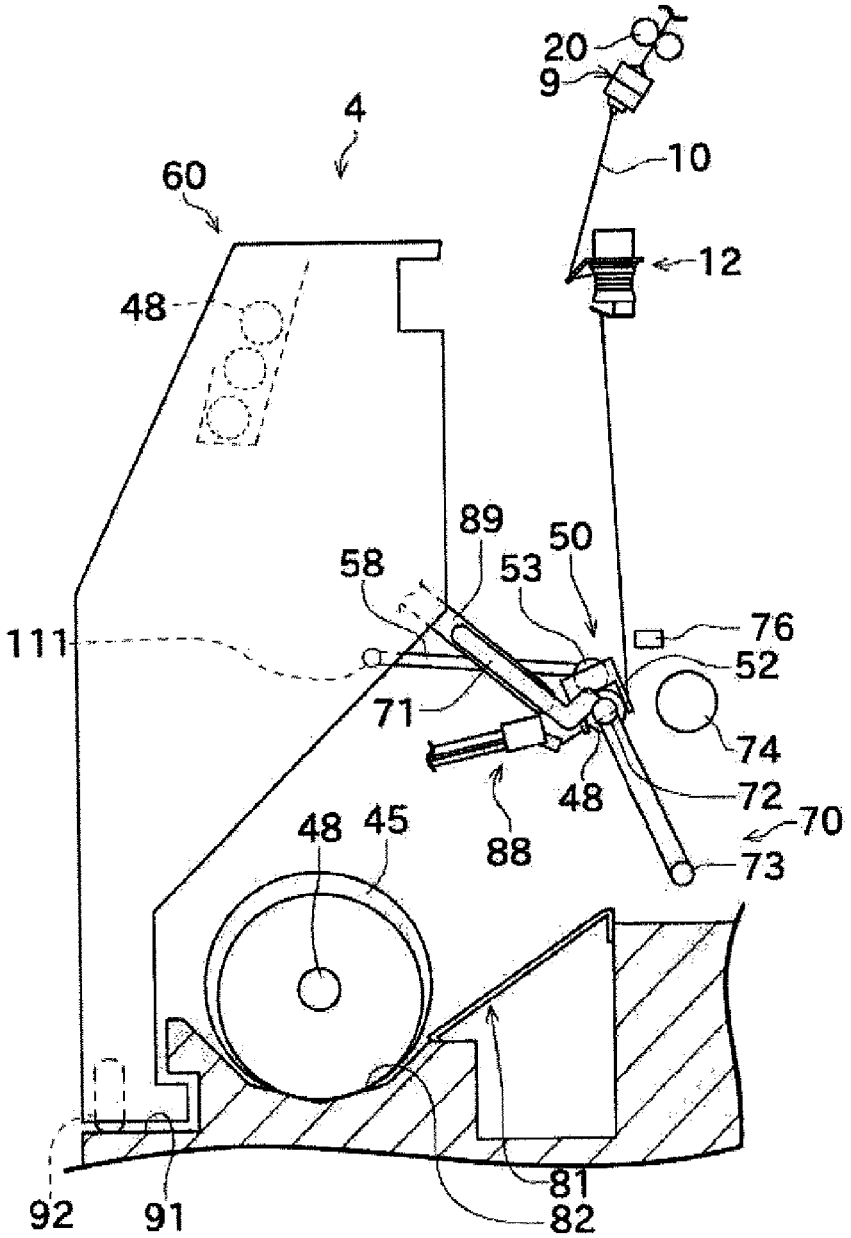
FIG.8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50
58
53
76
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74
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70
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73
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92
91
82

FIG.9C

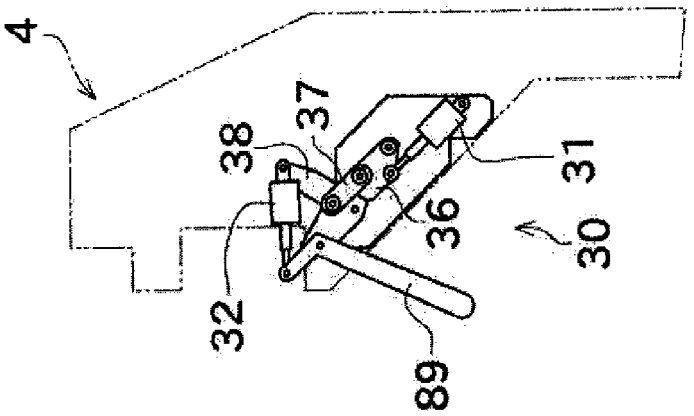


FIG.9B

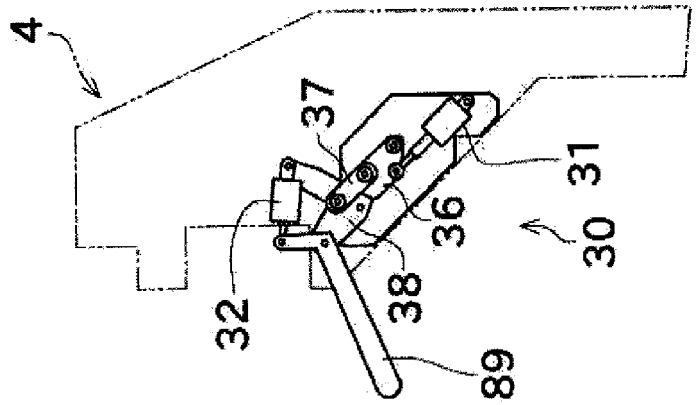


FIG.9A

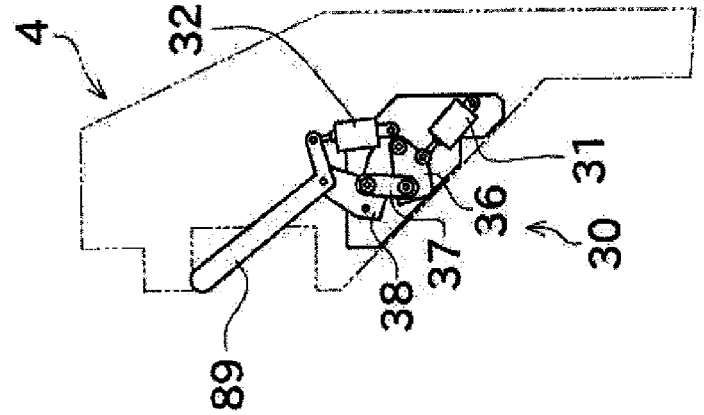


FIG.10C

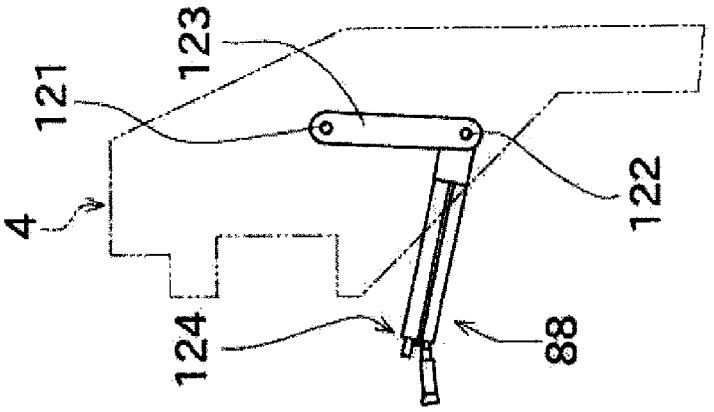


FIG.10B

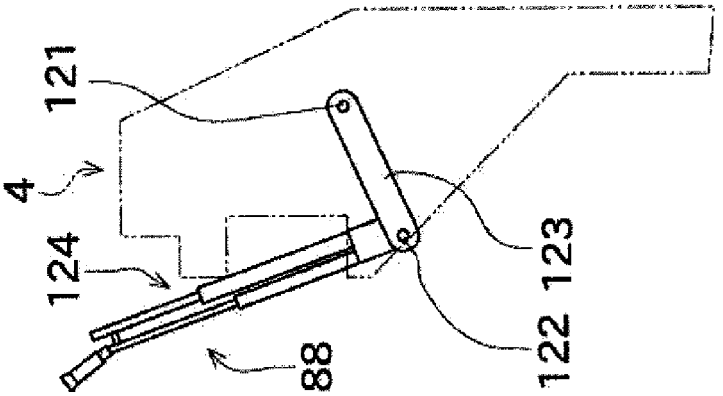
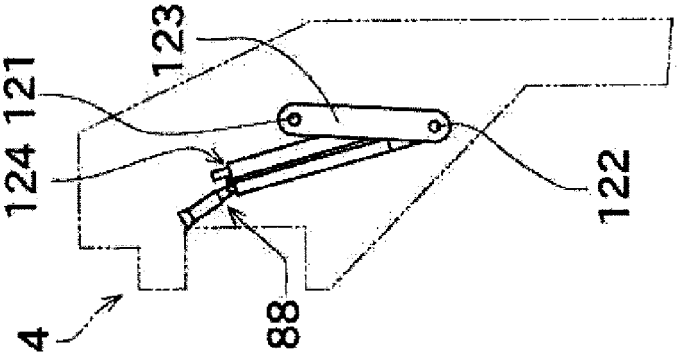


FIG.10A



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005219880 A **[0002] [0003] [0005] [0008]**
- JP H9100066 B **[0002] [0004] [0008]**