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

(11) EP 2 441 720 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.04.2012 Bulletin 2012/16

(21) Application number: **11180050.4**

(22) Date of filing: **05.09.2011**

(51) Int Cl.:
B65H 67/04 *(2006.01)* ***D01H 9/04*** *(2006.01)*
D01H 9/08 *(2006.01)*

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

(30) Priority: **18.10.2010 JP 2010233731**

(71) Applicant: **Murata Machinery, Ltd.**
Kyoto-shi,
Kyoto 6018326 (JP)

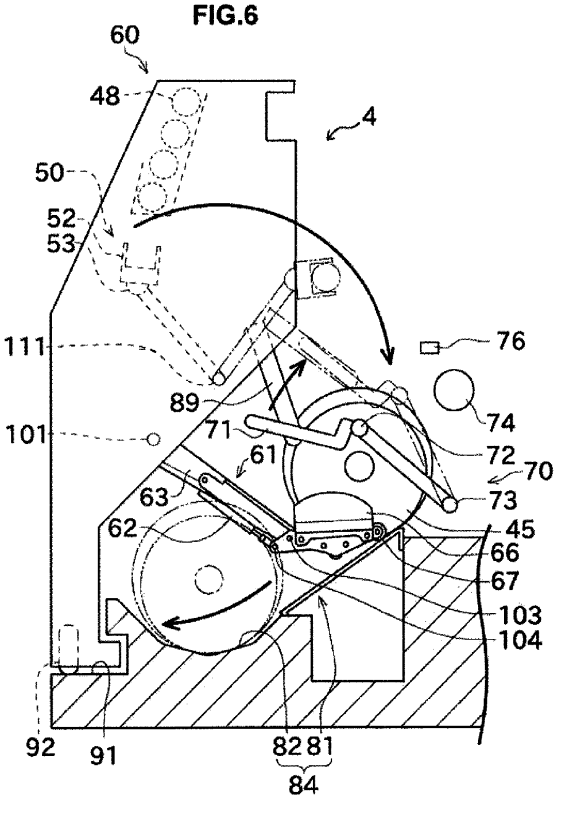
(72) Inventors:
- **Shiota, Takeshi**
  Kyoto, Kyoto 612-8686 (JP)
- **Tsuji, Hiroshi**
  Kyoto, Kyoto 612-8686 (JP)

(74) Representative: **Beck, Alexander et al**
Hansmann & Vogeser
Patent- und Rechtsanwälte
Maximilianstrasse 4b
82319 Starnberg (DE)

(54) Doffer and yarn winding apparatus including the same

(57) A doffer (60) includes support members (65) and a bobbin guiding cylinder (62). The support members (65) support a package formed by winding a spun yarn on a bobbin. The bobbin guiding cylinder (62) drives the support members (65) to convey a fully wound package supported by the support members (65) from a position (first position) of the package at which the support members (65) receive the package that is fully wound to a position of a package receiving section (84) (second position).

FIG.6



EP 2 441 720 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention generally relates to doffers and yarn winding apparatuses including the same.

2. Description of the Related Art

[0002] A doffer that removes a fully wound package or the like is generally included in yarn winding apparatuses such as spinning devices. For example, yarn winding apparatuses (spinning devices, textile machines) of this type are disclosed in Japanese published unexamined application No. H9-100066 and Japanese published unexamined application No. 2005-220484.

[0003] A package loading area is provided between a spinning unit and a doffer carrier in the spinning device disclosed in Japanese published unexamined application No. H9-100066. A guide arm member of the doffer carrier dismounts a package fully wound by the spinning unit from a cradle that holds a bobbin, receives the package with a stay, and thereafter drops the package toward the package loading area.

[0004] A loading area is provided in also the textile machine disclosed in Japanese published unexamined application No. 2005-220484. The loading area is located closer to a front-surface side of the textile machine than a doffer carrier. The doffer carrier includes a sloped floor for moving a package by causing the package to roll down. With this configuration, the package that is fully wound and dismounted from a cradle rolls down the sloped floor to the loading area.

[0005] However, with the configuration disclosed in Japanese published unexamined application No. H9-100066, the package may be damaged when it falls on the package loading area.

[0006] Japanese published unexamined application No. H9-100066 and Japanese published unexamined application No. 2005-220484 disclose only methods for carrying a cheese-shaped package but do not disclose, for example, a method for carrying a conical package, a method for changing a package to be wound, and the like.

[0007] In particular, winding a conical package with the configuration disclosed in Japanese published unexamined application No. 2005-220484 can cause the package to turn to a small-diameter side of the package when rolling down the sloped floor and result in collision between the package and other components of the textile machine. Such collision not only can damage the package but also causes the package to be caught by the component and results in a failure to appropriately move the package to the loading area in some cases.

[0008] In the configuration disclosed in Japanese published unexamined application No. 2005-220484, the sloped floor extends through the doffer carrier. This configuration limits a freedom in arrangement of components of the doffer carrier and the like and results in an increase in size of the doffer carrier or an increase in complexity of mechanism to avoid interference in layout.

SUMMARY OF THE INVENTION

[0009] It is an object of the present invention to provide a doffer that reduces an impact given to a package during doffing and that is adaptable to packages of various shapes. This is achieved by a doffer according to claim 1.

[0010] According to a first aspect of the present invention, a doffer that doffs a package formed by winding a yarn on a bobbin includes a support member and a driving section. The support member is adapted to support the package. The driving section is adapted to drive the support member to convey the package supported by the support member from a first position to a second position.

[0011] Thus, the package is conveyed in a state where the at least a part of weight of the package is supported by the support member, and hence collision between the package and a component or the like at the second position that would otherwise be caused by a free fall of the package is prevented. Accordingly, an impact given to the package can be reduced. Therefore, damage and quality degradation of the package during a doffing operation performed by the doffer are prevented.

[0012] The support member of the doffer preferably includes a support member that is interchangeable with a different support member according to a shape of the package to be formed.

[0013] Packages of varying shapes including cheese-shape and conical can be formed by appropriately using one of the support members and a uniform contact can be achieved between the support member and a surface of the package. Accordingly, local application of a large load on the package can be prevented. This structure also reduces the number of components to be interchanged and facilitates an interchanging operation as compared to a structure that requires not only the support member but also a member for carrying the package to be interchanged each time a package of a different shape is to be formed.

[0014] The doffer preferably includes a rotation stopping section that is adapted to stop inertial rotation of the package before the support member starts supporting the package by making contact with the package.

[0015] A movement of a rotating package can cause the package to roll down in an unexpected direction and result in falling of the package out of the support member. In such a case, damage can occur to the package due to an impact given to the package by the fall or a failure to appropriately carry the package to the second position. However, the rotation stopping section stops the rotation of the package and thereafter causes the package to move, thereby preventing falling of the package out of the support member.

[0016] The doffer preferably includes a restricting

member adapted to restrict a position of the package in an axial direction of the package while the package is being conveyed.

[0017] The restricting member prevents the package from falling out of the support member, thereby preventing damage to the package due to an impact that would otherwise be given to the package by the fall and also preventing a failure to carry the package to the second position. Furthermore, the structure of the doffer can be simplified as compared to a structure in which a restricting member that restricts a path of movement of the package extends from the first position to the second position.

[0018] According to a second aspect of the present invention, a yarn winding apparatus includes a winding device, a package receiving section, and a doffer. The winding device is adapted to wind a yarn on a bobbin to form a package. The package receiving section, which is arranged at a position lower than a position of the winding device, is adapted to receive the package wound by the winding device. The doffer is adapted to doff the package from the winding device and convey the package to the package receiving section. The doffer includes a support member and a driving section. The support member is adapted to support the package doffed from the winding device and supports at least a part of the weight of the package at an instant when the package comes into contact with the package receiving section. The driving section is adapted to drive the support member to convey the package supported by the support member from the winding device to the package receiving section.

[0019] Accordingly, an impact given to the package by the package receiving section when the doffer unloads the package to the package receiving section can be reduced. Therefore, it is possible to prevent damage and quality degradation of the package during a doffing operation.

[0020] The support member of the doffer preferably includes a support member that is interchangeable with a different support member according to a shape of the package to be formed.

[0021] Packages of varying shapes including cheese-shape and conical can be formed by appropriately using one of the support members and a uniform contact can be achieved between the support member and a surface of the package. As a result, local application of a large load on the package can be prevented. This structure also reduces the number of components to be interchanged and facilitates an interchanging operation as compared to a structure that requires not only the support member but also a member for carrying the package to be interchanged each time a package of a different shape is to be formed.

[0022] The doffer of the yarn winding apparatus preferably includes a rotation stopping section adapted to stop inertial rotation of the package before the support member starts supporting the package by making contact with the package.

[0023] A movement of a rotating package can cause the package to roll down in an unexpected direction and result in falling of the package out of the support member. In this case, damage can occur to the package due to an impact given to the package by the fall or a failure to appropriately carry the package to the package receiving section. However, the rotation stopping section stops the rotation of the package and thereafter causes the package to move, thereby preventing falling of the package out of the support member.

[0024] The doffer of the yarn winding apparatus preferably includes a restricting member adapted to restrict a position of the package in an axial direction of the package while the package is being conveyed.

[0025] The restricting member prevents the package from falling out of the support member, thereby preventing damage to the package due to an impact given to the package by the fall and a failure to carry the package to the package receiving section. The structure of the yarn winding apparatus can be simplified as compared to a structure in which a restricting member that restricts a path of movement of the package extends from the winding device to the package receiving section.

[0026] The package receiving section of the yarn winding apparatus includes a receptacle and a sloping member. The package is loaded on the receptacle. The package rolls down on the sloping member toward the receptacle. The doffer brings the package into contact with the sloping member, and thereafter carries the package to the receptacle by causing the package to roll down the sloping member.

[0027] Accordingly, the sloping member supports a part of the weight of the package while the package is moving on the sloping member, thereby reducing the magnitude of a load applied to the support member. Furthermore, the package can be moved by rolling down rather than being dragged. Accordingly, concentration of the load at one point on an outer peripheral surface of the package can be prevented.

[0028] The doffer of the yarn winding apparatus preferably includes a roller member that is rollable on the sloping member.

[0029] The roller member makes it possible to smoothly move the support member along the sloping member and carry the package to the receptacle appropriately. Dragging the support member along the sloping member causes the support member and the sloping member to wear. The roller member prevents this wear, thereby increasing durability of the doffer.

[0030] The winding device of the yarn winding apparatus includes a bobbin holding section adapted to hold the bobbin. The doffer includes an operating section adapted to dismount the package from the bobbin holding section. The operating section dismounts the package from the bobbin holding section while the support member is in contact with the package.

[0031] Thus, dismounting of the package is performed in a state in which the package is supported by the support member. Accordingly, falling of the dismounted

package from a position of the winding device that leads to giving an impact to the package is prevented. Therefore, the yarn winding apparatus can prevent damage and quality degradation of the package during the doffing operation of the package.

[0032] The yarn winding apparatus includes a bobbin supplying section adapted to supply the bobbin, on which the yarn is to be wound, to the winding device. The doffer moves the support member away from the winding device and supplies the bobbin from the bobbin supplying section to the winding device simultaneously.

[0033] In the yarn winding apparatus configured in this way, the bobbin supplying section supplies the bobbin, which is a new one, to the winding device while the doffer is carrying the package to the package receiving section. Accordingly, improvement in efficiency in yarn winding performed by the yarn winding apparatus can be achieved.

[0034] The yarn winding apparatus includes a plurality of winding devices. The winding devices are arranged in one direction. The doffer is movable in the direction in which the winding devices are arranged.

[0035] Such a structure allows reduction in the number of the doffers to be provided as compared to a structure in which the doffers are provided on a per-winding-device basis, thereby achieving cost reduction.

[0036] 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

[0037]

FIG. 1 is a schematic elevation view of an overall structure of a spinning machine according to an embodiment of the present invention;

FIG. 2 is a longitudinal cross-sectional view of the spinning machine illustrated in FIG. 1;

FIG. 3 is a perspective view of a guiding section illustrated in FIG. 2;

FIGS. 4A and 4B are schematic diagrams of exemplary shapes, which are appropriate to shapes of a package, of support members illustrated in FIG. 2;

FIG. 5 is a longitudinal cross-sectional view illustrating how the guiding section illustrated in FIG. 3 stops inertial rotation of the package; and

FIG. 6 is a longitudinal cross-sectional view for describing a doffing operation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0038] Exemplary embodiments of the present invention are described in detail below with reference to the accompanying drawings.

[0039] 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 description 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.

[0040] The spinning machine 1 illustrated in FIG. 1 includes a plurality of spinning 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.

[0041] As illustrated 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.

[0042] The drafting device 7 drafts a sliver 15 into the fiber bundle 8. As illustrated 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.

[0043] Although a detailed structure of the spinning device 9 is not illustrated, in the present embodiment, an airjet-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.

[0044] 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 illustrated 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.

[0045] 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.

[0046] 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.

[0047] 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 illustrated) implemented as, for example, a magnetic-torque generating section. 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. 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.

[0048] 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. 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.

[0049] 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.

[0050] 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 illustrated). 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.

[0051] 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.

[0052] As illustrated 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.

[0053] The suction pipe 44 is vertically pivotable about a shaft. The suction pipe 44 sucks and catches a yarn end (upper yarn) of the yarn 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 yarn 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 splicer 43 splices the upper yarn and the lower yarn by twisting yarn ends by using a swirling airflow.

[0054] 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.

[0055] 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 illustrated) 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 illustrated). Thus, the winding device 13 winds the spun yarn 10 while causing the spun yarn 10 to traverse.

[0056] A spring (not illustrated) 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 winding device 13, and hence a position of the axis of the package 45 is moved forward. A driving section (not illustrated) (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. When the package 45 is fully wound, the cradle arm 71 is pivoted in the direction away from the winding drum 74 to prevent transmission of driving force of the winding drum 74 to the package 45. Even after the package 45 is separated from the winding drum 74, the package 45 continues rotating by the inertia force (hereinafter, "inertial rotation").

[0057] As illustrated in FIGS. 1 and 2, the doffer carrier 4 includes a doffer 60. The doffer 60 performs a bobbin installing operation that includes supplying the bobbin 48 to the cradle 70 to prepare for winding of the spun yarn 10 and a doffing operation that includes dismounting the fully wound package 45 from the cradle 70. The doffer carrier 4 has wheels 92 at its bottom. Upon receiving an instruction to perform the bobbin installing operation or the doffing operation on one of the spinning units 2, the doffer carrier 4 travels on a travel lane 91 formed on the frame 6 to the corresponding spinning unit 2, 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.

[0058] The doffer 60 includes, as elements for performing the bobbin installing operation, a bobbin supplying section 50, a suction pipe 88, and a cradle operating arm (operating section) 89.

[0059] 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 and carries the spun yarn 10 to the winding device 13.

[0060] The bobbin supplying section 50 that includes a bobbin holding section 52 is pivotable about a rocker shaft 111 and is capable of holding the bobbin 48 with the bobbin holding section 52. The doffer 60 causes the bobbin supplying section 50, which is holding the bobbin 48, to pivot, thereby supplying the bobbin 48 to a position between the pair of bobbin holders 72 of the cradle 70. The bobbin supplying section 50 includes a bunch winding roller 53 for performing bunch winding. The 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. A detailed structure of the bobbin supplying section 50 is described later.

[0061] The cradle operating arm 89 is capable of operating the cradle arm 71 in a manner 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, orientation of the cradle arm 71 changes. The cradle operating arm 89 is configured such that the position of the cradle operating arm 89 can be changed by a cam mechanism (not illustrated) or the like. Accordingly, the cradle operating arm 89 can perform the separating operation during each of the doffing operation (FIG. 5) of dismounting the fully wound package 45 and the bobbin installing operation (FIG. 6).

[0062] As illustrated in FIG. 2, the doffer 60 includes a guiding section 61. The guiding section 61 receives the fully wound package 45 from the cradle 70 and carries the fully wound package 45 to a package receiving section 84 of the spinning machine 1.

[0063] The package receiving section 84 includes a sloping member 81 and a receptacle 82. The package 45 rolls on the sloping member 81 and is temporarily loaded on the receptacle 82. The receptacle 82 is coupled to one end of the sloping member 81. The sloping member 81 and the receptacle 82 contact with the peripheral surface of the package 45. The sloping member 81 and the receptacle 82 are arranged at positions lower than a position of the bobbin holders 72 (more specifically, positions lower than the position of the package 45 supported by the bobbin holders 72).

[0064] 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 automatically deliver the package 45 to a subsequent process. Alternatively, a configuration 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 can be employed.

[0065] A structure of the guiding section 61 is described below with reference to FIGS. 2 to 4B. FIG. 3 is a perspective view of the guiding section 61. FIGS. 4A and 4B are schematic diagrams of exemplary shapes, which are appropriate to shapes of the package 45, of support members.

[0066] As illustrated in FIG. 3, the guiding section 61 includes a pivot arm 63, a bobbin guiding cylinder (driving section) 62 illustrated in FIG. 2, a pair of mounting plates 68, support members (rotation stopping section) 65, restricting members 66, and roller members 67.

[0067] A rotary shaft 101 is attached to one end of the pivot arm 63. The guiding section 61 includes a motor (not illustrated). The guiding section 61 causes the pivot arm 63 to pivot about the rotary shaft 101 by virtue of a driving force produced by the motor. Upward pivoting action of the pivot arm 63 leads to a movement of the guiding section 61 from the side of the doffer carrier 4 to the side of the winding device 13, thereby bringing a distal end of the guiding section 61 toward the package 45. In contrast, downward pivoting action of the pivot arm 63 causes the guiding section 61 to retract to the side of the doffer carrier 4 to be tucked.

[0068] A rotary shaft 103 is rotatably coupled to a lead-

ing end of the pivot arm 63. The pair of mounting plates 68 arranged substantially parallel to each other is fixed onto the ends of the rotary shaft 103. One end of the bobbin guiding cylinder 62 illustrated in FIG. 2 is coupled to the mounting plates 68 via an acting shaft 104. The other end of the bobbin guiding cylinder 62 is coupled to a basal end of the pivot arm 63. The bobbin guiding cylinder 62 is extended or shortened by controlling the air pressure inside the bobbin guiding cylinder 62.

[0069] By extending or shortening the bobbin guiding cylinder 62 by adjusting the air pressure, a force is exerted on the acting shaft 104, causing the mounting plates 68 to pivot about the rotary shaft 103. More specifically, when the bobbin guiding cylinder 62 is extended, the mounting plates 68 pivot upward, whereas when the bobbin guiding cylinder 62 is shortened, the mounting plates 68 pivot downward.

[0070] The support members 65, the restricting members 66, and the roller members 67 are coupled to the mounting plates 68.

[0071] Each of the support members 65 is a flat, plate-like member. The support members 65 are arranged in a line. Each of the support members 65 is arranged to straddle the pair of mounting plates 68. The two support members 65 form a contact surface (support surface) that has a shallow V-shaped valley at its center portion as illustrated in FIG. 3.

[0072] Causing the support members 65 to pivot upward together with the mounting plates 68 by extending the bobbin guiding cylinder 62 brings the support members 65 into contact with the package 45 held by the bobbin holders 72. The inertial rotation of the package 45 can be stopped in this way. The support members 65 can carry the package 45 to the sloping member 81 while supporting at least a part of the weight of the package 45 received from the cradle 70. Furthermore, the support members 65 continue contacting the package 45 even after the package 45 makes contact with the sloping member 81, thereby carrying the package 45 to the receptacle 82 along the sloping member 81.

[0073] As illustrated in FIG. 4A, each of the support members 65 includes a contact portion 65a that is to come into contact with the outer peripheral surface of the package 45, and attaching portions 65b and 65c that are to be attached to the mounting plates 68. Meanwhile, FIG. 4A illustrates, of the two support members 65, one support member 65 arranged on the side of the winding device 13.

[0074] It is necessary to bring the support members 65 into uniform contact with the surface of the package 45 to stop rotation of the package 45 and to carry the package 45 appropriately. More specifically, when the force exerted by the support members 65 on the package 45 is nonuniform, a large load will be applied on a part of the package 45. As a result, the package 45 can be damaged. Accordingly, when the package 45 having a conical shape is to be wound, as illustrated in FIG. 4A, the support members 65, which are tapered because the lengths of the attaching portions 65b and 65c are adjusted to conform to the conical shape, should preferably be used. When a cheese-shaped package is to be wound, as illustrated in FIG. 4B, the support members 65, which are straight because the lengths of the attaching portions 65b and 65c are equal to each other, should preferably be used.

[0075] The support members 65 illustrated in FIGS. 4A and 4B can be dismounted from the mounting plates 68 relatively easily by removing a fixing member (e.g., a bolt). Thus, even when a package of a different shape is to be formed on the spinning machine 1, only the support members 65 need to be changed to cause the doffer 60 to perform the doffing operation of the new package of the new shape.

[0076] Each of the restricting members 66 is formed in a flat-plate-like shape and attached substantially upright to the mounting plates 68. The two restricting members 66 are arranged substantially parallel to each other. The restricting members 66 restrict an axial position of the package 45 received from the cradle 70 from both sides of the package 45. Thus, the restricting members 66 prevent the package 45 received from the cradle 70 from falling out of the contact portions 65a.

[0077] The roller members 67 are supported to be rotatable relative to the mounting plates 68. The roller members 67 roll on the sloping member 81 when the guiding section 61 carries the package 45 along the sloping member 81. The doffer 60 configured in this way smoothly carries the package 45 and simultaneously saves wear on the guiding section 61, the sloping member 81, and the like. Meanwhile, the guiding section 61 according to the present invention includes three pairs of the roller members 67 (six roller members in total).

[0078] A sequence of the doffing operation and the bobbin installing operation that the doffer 60 performs is described below with reference to FIGS. 5 and 6. FIG. 5 is a longitudinal cross-sectional view for describing how the guiding section 61 stops the inertial rotation of the package 45. FIG. 6 is a longitudinal cross-sectional view for describing the doffing operation. In the present embodiment, the doffing operation and the bobbin installing operation are performed simultaneously and concurrently.

[0079] When it is detected by a sensor (not illustrated) 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 doffer carrier 4 to travel to the corresponding spinning unit 2. Substantially concurrently therewith, the unit controller causes 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 to prevent transmission of driving force to the package 45. Even after the package 45 is separated from the winding drum 74, the package 45 continues the inertial rotation.

[0080] Upon reaching the spinning unit 2 as commanded by the unit controller, the doffer 60 causes the pivot arm 63 to pivot upward, thereby bringing the leading end of the guiding section 61 toward the package 45. In this state, the doffer 60 supplies compressed air to the bobbin guiding cylinder 62 to extend the bobbin guiding cylinder 62, thereby causing the support members 65 to pivot upward into contact with the peripheral surface of the package 45. The doffer 60 thus applies brake on the surface of the package 45 by generating friction between the surface of the package 45 and the support members 65, thereby stopping the inertial rotation of the package 45 (see FIG. 5). Even after the inertial rotation of the package 45 is stopped completely, the doffer 60 maintains a contact between the support members 65 and the package 45. In the following description, a position of the package 45 at which the support members 65 receive the package 45 from the cradle 70 is referred to as a "first position".

[0081] Until the inertial rotation of the package 45 is stopped completely, the doffer 60 retracts the cradle operating arm 89 to a position (cradle operable position) illustrated in FIG. 5. When the package 45 is stopped completely, the doffer 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.

[0082] At this time, the support members 65 are kept contacting the package 45 as described above. Accordingly, falling of the package 45 on the support members 65 or directly on the sloping member 81 will not occur, and hence no impact is given to the package 45. As described above, by selecting and using the support members 65 having a shape suitable for the shape of the package 45, the doffer 60 causes the support members 65 to make contact with the package 45 at a relatively large contact area, thereby stably supporting (carrying) the package 45 without wobbling.

[0083] The doffer 60 gradually lowers the pressure of air supplied to the bobbin guiding cylinder 62, thereby causing the support members 65 to pivot downward while supporting at least a part of the weight of the dismounted fully wound package 45. Causing the pivot arm 63 to pivot downward as required while simultaneously causing the support members 65 to pivot downward brings the package 45 into contact with the sloping member 81 (the package receiving section 84, or a second position) (see FIG. 6). The doffer 60 conveys the package 45 supported by the support members 65 from the first position to the second position in this way.

[0084] As described above, at a time point when the package 45 comes into contact with the sloping member 81, at least a part of the weight of the package 45 is supported by the support members 65, while the remaining part of the weight is supported by the sloping member 81 (the package receiving section 84). The support members 65 reliably support the weight of the package 45 until at a time point at which the package 45 comes into contact with the sloping member 81 in this way. Accordingly, the doffer 60 is less prone to degradation in quality of the package 45.

[0085] The doffer 60 causes the pivot arm 63 to further pivot downward from the state illustrated in FIG. 6 while keeping the support members 65 in contact with the package 45, thereby moving the guiding section 61 diagonally downward in a direction away from the cradle 70. Thus, the doffer 60 carries the package 45 to the receptacle 82 in a manner of rolling down the package 45 along the sloping member 81 (see broken lines illustrated in FIG. 6).

[0086] In the present embodiment, even after the package 45 makes contact with the sloping member 81, the guiding section 61 (the support members 65) supports the portion of the package 45 until the package 45 reaches the receptacle 82. Accordingly, even in a case, for example, in which it is necessary to set the angle of the sloping section 81 to a steep angle for making of the spinning machine 1 compact, the doffer 60 can move the package 45 to the receptacle 82 while performing control to prevent rolling momentum of the package 45 from becoming too steep. Meanwhile, when the package 45 is carried along the sloping member 81, the roller members 67 are in contact with the sloping member 81. Accordingly, by virtue of the roller members 67 that rotate on the sloping member 81 in a rolling manner, the guiding section 61 can be moved smoothly.

[0087] Meanwhile, if the package 45 having a conical shape rolls down the sloping member 81 freely, as described above, a moving path of the package 45 has a curvature toward the small-diameter portion of the package 45 rather than a straight line. However, in the present embodiment, the package 45 is carried along the sloping member 81 while the end surfaces in the axial direction of the package 45 are restricted by the restricting members 66. Accordingly, it is possible to roll down even the package 45 having the conical shape straight toward the receptacle 82.

[0088] Meanwhile, the doffer 60 also performs the bobbin installing operation during the doffing operation concurrently. More specifically, when the package 45 is dismounted from the bobbin holders 72, the doffer 60 places the cradle arm 71 in a state of being pivoted toward the winding drum 74 and then moves the cradle operating arm 89 to a position where the cradle operating arm 89 can operate the cradle 70 (see broken lines illustrated in FIG. 6). Before the bobbin 48 is supplied, the cradle operating arm 89 operates the cradle arm 71 in advance to move one of the bobbin holders 72 away from the other bobbin holder 72.

[0089] After the cradle operating arm 89 has performed the operation described above, or concurrently with the operation, the doffer 60 holds the bobbin 48 stored in the doffer carrier 4 with the bobbin supplying section 50 (the bobbin holding section 52), and thereafter causes the bobbin supplying section 50 to pivot, thereby supplying the bobbin 48 to the bobbin holders 72 of the cradle 70

(see FIG. 6). While the bobbin supplying section 50 is operated in this way, the guiding section 61 conveys the package 45 to the receptacle 82. In other words, an operation of moving the guiding section 61 away from the bobbin holders 72 and an operation of moving the bobbin supplying section 50 toward the bobbin holders 72 are performed concurrently and simultaneously. By virtue of coordination between the operations as described above, the winding device 13 can remove the package 45 and install the bobbin 48, which is a new one, in a relatively short period of time.

[0090] The doffer 60 operates the cradle arm 71 by using the cradle operating arm 89 to cause the bobbin 48 to be held in the bobbin holders 72. When the bobbin 48 has been installed in the bobbin holders 72, the doffer 60 performs bunch winding by releasing the holding of the bobbin 48 by the bobbin holding section 52 and simultaneously bringing the bunch winding roller 53 into contact with the bobbin 48. When the bunch winding is completed, the bobbin supplying section 50 retracts to the doffer 60 side. Substantially concurrently with the retraction of the bobbin supplying section 50, the unit controller of the spinning unit 2 causes the cradle 70 to pivot about the support shaft 73 so as to bring the bobbin 48 into contact with the winding drum 74. Thus, 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 winding to be started.

[0091] As described above, the doffer 60 according to the present embodiment includes the support members 65 and the bobbin guiding cylinder 62. The support members 65 support the package 45 formed by winding the spun yarn 10 on the bobbin 48. The bobbin guiding cylinder 62 drives the support members 65 to convey the fully wound package 45 supported by the support members 65 from the position (the first position) of the package 45 at which the support members 65 receive the fully wound package 45 to the package receiving section 84 (the second position).

[0092] Thus, the package 45 is conveyed while at least a part of the weight of the package 45 is supported by the support members 65. Accordingly, an impact given to the package 45 by the package receiving section 84 by the pull of gravity when the doffer 60 unloads the package 45 onto the package receiving section 84 can be reduced. Therefore, damage and quality degradation of the package 45 during the doffing operation performed by the doffer 60 can be prevented.

[0093] In the doffer 60 according to the present embodiment, the support members 65 are interchangeable according to the shape of the package 45.

[0094] Accordingly, by using the support members 65 having a shape suitable for the package 45 that can come in varying shapes including cheese winding and conical winding, a uniform contact can be achieved between the support members 65 and the surface of the package 45. Therefore, local application of a large load on the package 45 can be prevented. This structure also reduces the number of components to be interchanged and facilitates an interchanging operation as compared to a structure in which the entire guiding section 61 is changed each time a package of a different shape is to be formed. Using the support members 65 having the shape suitable for the package 45 makes it possible for the guiding section 61 to receive the package 45 from the winding device 13 while maintaining an orientation of the package 45 supported by the cradle 70. Accordingly, the doffer 60 can perform the doffing operation in a limited space. Therefore, it is desirable that the spinning machine 1 that includes a number of the spinning units 2 in a limited space adopts the structure of the doffer 60 according to the present embodiment.

[0095] The doffer 60 according to the present embodiment includes the support members 65 serving as the rotation stopping section that stops, after the spun yarn 10 has been wound on the package 45, the inertial rotation of the package 45.

[0096] Moving the package 45 that is rotating can undesirably cause the package 45 to roll down in an unexpected direction and result in a failure to appropriately carry the package 45 to the package receiving section 84. However, the doffer 60 stops the rotation of the package 45 and thereafter causes the package 45 to move. Accordingly, the doffer 60 can reliably carry the package 45 to the package receiving section 84 (the second position). The guiding section 61 of the doffer 60 includes the support members 65. Accordingly, the doffer 60 can stop the rotation of the package 45 and carry the package 45 in one sequence of operations. In particular, in the present embodiment, the bobbin guiding cylinder 62 drives the support members 65. Accordingly, it is easy to adjust the magnitude of the force at which the support members 65 are pressed against the package 45 by adjusting the air pressure. Therefore, it is possible to bring the support members 65 into contact with the package 45 with a contact force that does not cause the package 45 to be damaged by friction on the support members 65 but that is strong enough to immediately stop the rotation of the package 45.

[0097] The doffer 60 according to the present embodiment includes the restricting members 66 that restrict the position of the package 45 in the axial direction when the package 45 is carried.

[0098] The restricting members 66 prevent the package 45 from falling out of the support members 65, thereby preventing damage to the package 45 due to an impact given to the package 45 by the fall. The restricting members 66 also cause the package 45 to travel straight when the package 45 rolls down the sloping member 81. This effect is particularly effective for a conical package that draws a curved path when the conical package rolls down without being restricted by the restricting members 66. The restricting members 66 further simplify the structure of the spinning machine 1 as compared to a structure in which restricting members that restrict a moving path of the package 45 are provided on the package receiving

section 84 side (for each of the spinning units 2).

[0099] The spinning machine 1 according to the present embodiment includes the doffer 60, the winding device 13, and the package receiving section 84. The winding device 13 forms the package 45 by winding the spun yarn 10 on the bobbin 48. The package receiving section 84 is arranged at a position lower than the position of the winding device 13. The package 45 wound by the winding device 13 is loaded on the package receiving section 84. The doffer 60 doffs the package 45 from the winding device 13 and conveys the package 45 to the package receiving section 84. The doffer 60 includes the support members 65 and the driving section 62. The support members 65 support at least a part of the weight of the package 45 at an instant when the package 45 comes into contact with the package receiving section 84. The driving section 62 drives the support members 65 to convey the package 45 supported by the support members 65 from the winding device 13 to the package receiving section 84.

[0100] Accordingly, an impact given to the package 45 by the package receiving section 84 by the pull of gravity when the doffer 60 unloads the package 45 onto the package receiving section 84 can be reduced. Therefore, it is possible to prevent damage and quality degradation of the package 45 during the doffing operation.

[0101] In the spinning machine 1 according to the present embodiment, the support members 65 are interchangeable according to the shape of the package 45. Accordingly, by using the support members 65 having a shape suitable for the package 45 that can come in varying shapes including cheese-shaped winding and conical winding, a uniform contact can be achieved between the support members 65 and the surface of the package 45. As a result, local application of a large load on the package 45 can be prevented. This structure also reduces the number of components to be interchanged and facilitates an interchanging operation as compared to a structure that requires not only the support members 65 but also a member for carrying the package 45 to be changed each time a package of a different shape is to be formed.

[0102] In the spinning machine 1, the doffer 60 preferably includes the rotation stopping section 65 that comes into contact with the package 45 to stop the inertial rotation of the package 45 before the support members 65 start supporting the package 45.

[0103] A movement of the rotating package 45 can cause the package 45 to roll down in an unexpected direction and result in falling of the package 45 out of the support members 65. In this case, damage can occur to the package 45 due to an impact given to the package 45 by the fall or a failure to appropriately carry the package 45 to the package receiving section 84. However, the support members 65 stop the rotation of the package 45 and thereafter cause the package 45 to move. Accordingly, falling of the package 45 out of the support members 65 can be prevented.

[0104] In the spinning machine 1, the doffer 60 preferably includes the restricting members 66 that restrict the position of the package 45 in the axial direction when the package 45 is carried.

[0105] The restricting members 66 prevent the package 45 from falling out of the support members 65. Accordingly, a situation where the package 45 is damaged due to an impact given to the package 45 by the fall or the package 45 fails to be conveyed to the package receiving section 84 is prevented. The structure of the spinning machine 1 can be simplified as compared to a structure in which restricting members that restrict a path of movement of the package 45 extend from the winding device to the package receiving section.

[0106] In the spinning machine 1 according to the present embodiment, the package receiving section 84 includes the receptacle 82 and the sloping member 81. The package 45 is loaded on the receptacle 82. The package 45 rolls down toward the receptacle 82 on the sloping member 81. The guiding section 61 of the doffer 60 brings the package 45 into contact with the sloping member 81 and thereafter carries the package 45 to the receptacle 82 on the sloping member 81 by causing the package 45 to roll down the sloping member 81.

[0107] Accordingly, the sloping member 81 supports a part of the weight of the package 45 while the package 45 is moving on the sloping member 81, thereby reducing the magnitude of a load applied to the support members 65. The doffer 60 is capable of moving the package 45 by rolling down the package 45 rather than dragging the package 45. Accordingly, concentration of the load at one point on the outer peripheral surface of the package 45 can be prevented.

[0108] In the spinning machine 1 according to the present embodiment, the guiding section 61 of the doffer 60 includes the roller members 67 that are rollable on the sloping member 81.

[0109] The roller members 67 enable a smooth movement of the support members 65 along the sloping member 81 leading to an appropriate movement of the package 45 to the receptacle 82. Dragging the support members 65 along the sloping member 81 causes the support members 65 and the sloping member 81 to wear. The roller members 67 prevent this wear and increase durability of the doffer 60.

[0110] In the spinning machine 1 according to the present embodiment, the winding device 13 includes the bobbin holders 72 adapted to hold the bobbin 48. The doffer 60 includes the cradle operating arm 89 adapted to dismount the package 45 from the bobbin holders 72. The cradle operating arm 89 dismounts the package 45 from the bobbin holders 72 while the support members 65 are in contact with the package 45.

[0111] Thus, dismounting of the package 45 is performed in the state in which the package 45 is supported by the support members 65. Therefore, the dismounted package 45 is prevented from falling from the position of the winding device 13 and hence does not receive an

impact. Accordingly, a damage and quality degradation of the package 45 during the doffing operation can be prevented.

[0112] The spinning machine 1 according to the present embodiment includes the bobbin supplying section 50 that supplies the bobbin 48, on which the spun yarn 10 is to be wound, to the winding device 13. The doffer 60 is capable of moving the guiding section 61 (in particular, the support members 65) away from the winding device 13 and supplying the bobbin 48 from the bobbin supplying section 50 to the winding device 13 simultaneously.

[0113] Accordingly, while the guiding section 61 is carrying the package 45 to the package receiving section 84 (receptacle 82), the bobbin supplying section 50 can supply the bobbin 48, which is a new one, to the bobbin holders 72. 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 winding devices 13 are arranged in one direction. The doffer 60 can travel in the direction in which the winding devices 13 are arranged.

[0115] Such a structure allows reduction in the number of the doffers 60 that need to be provided as compared to a structure in which the doffers 60 are provided on a per-winding-device-13 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 a yarn winding device, other than a spinning machine, so long as the yarn winding device has a structure in which the package receiving section 84 where the package 45 is to be loaded is arranged at a position lower than that of the bobbin holders 72 in the direction of height of the spinning machine.

[0119] In the above-described embodiments, when a yarn defect is detected by the yarn clearer 49 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, in lieu of this structure, 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] In the above-described embodiments, the package receiving section 84 includes the sloping member 81 and the receptacle 82. However, in lieu of the package receiving section 84, a package receiving section that does not include a sloping member can be employed.

[0121] As the bobbin guiding cylinder 62 serving as the driving section, an oil hydraulic cylinder can be used in lieu of the pneumatic cylinder. A structure that uses a solenoid as the driving section or a structure that uses a cam and an electric motor as the driving section can yield a similar effect to that yielded by the above-described embodiments.

[0122] The location and the number of the roller members 67 are not limited to those described in the above embodiments. For example, a structure in which the roller members 67 are attached only to the leading end of the mounting plates 68 may be employed.

[0123] In the above-described embodiments, 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 may 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. The doffer 60 may be configured to perform only the doffing operation in a case in which another package is not to be formed after the doffing operation.

[0124] 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 doffer (60) that doffs a package formed by winding a yarn (10) on a bobbin (45), the doffer (60) comprising:

   a support member (65) adapted to support the package (48); and
   a driving section (62) adapted to drive the support member (65) to convey the package (48) supported by the support member (65) from a first position to a second position.

2. The doffer (60) according to Claim 1, wherein the support member (65) is interchangeable according to a shape of the package (48) to be formed.

3. The doffer (60) according to Claim 1 or 2, further comprising a rotation stopping section adapted to stop inertial rotation of the package (48) before the support member (65) starts supporting the package

(48) by making contact with the package (48).

4. The doffer (60) according to any one of Claims 1 to 3, further comprising a restricting member (66) adapted to restrict a position of the package (48) in an axial direction of the package (48) while the package (48) is being conveyed.

5. A yarn winding apparatus comprising:

a winding device (13) adapted to wind a yarn (10) on a bobbin (45) to form a package (48);
a package receiving section (84) adapted to receive the package (48) wound by the winding device (13), the package receiving section (84) being arranged at a position lower than a position of the winding device (13); and
a doffer (60) adapted to doff the package (48) from the winding device (13) and convey the package (48) to the package receiving section (84),

wherein the doffer (60) includes
a support member (65) adapted to support the package (48) doffed from the winding device (13) and support at least a part of weight of the package (48) at an instant when the package (48) comes into contact with the package receiving section (84); and
a driving section (62) adapted to drive the support member (65) to convey the package (48) supported by the support member (65) from the winding device (13) to the package receiving section (84).

6. The yarn winding apparatus according to Claim 5, wherein the support member (65) is interchangeable according to a shape of the package (48).

7. The yarn winding apparatus according to Claim 5 or 6, wherein the doffer (60) includes a rotation stopping section adapted to stop inertial rotation of the package (48) before the support member (65) starts supporting the package (48) by making contact with the package (48).

8. The yarn winding apparatus according to any one of Claims 5 to 7, wherein the doffer (60) includes a restricting member (66) adapted to restrict a position of the package (48) in an axial direction of the package (48) while the package (48) is being conveyed.

9. The yarn winding apparatus according to any one of Claims 5 to 8, wherein the package receiving section (84) includes
a receptacle (82) on which the package (48) is to be loaded; and
a sloping member (81) on which the package (48) rolls down toward the receptacle (82), and
the doffer (60) brings the package (48) into contact with the sloping member (81), and thereafter carries the package (48) to the receptacle (82) by causing the package (48) to roll down the sloping member (81).

10. The yarn winding apparatus according to Claim 9, wherein the doffer (60) includes a roller member (67) that is rollable on the sloping member (81).

11. The yarn winding apparatus according to any one of Claims 5 to 10, wherein
the winding device (13) includes a bobbin holding section (72) adapted to hold the bobbin (45), and
the doffer (60) includes an operating section (89) adapted to dismount the package (48) from the bobbin holding section (72), the operating section (89) dismounting the package (48) from the bobbin holding section (72) while the support member (65) is in contact with the package (48).

12. The yarn winding apparatus according to any one of Claims 5 to 11, further comprising a bobbin supplying section (50) adapted to supply the bobbin (45), on which the yarn (10) is to be wound, to the winding device (13), wherein
moving the support member (65) away from the winding device (13) and supplying the bobbin (45) from the bobbin supplying section (50) to the winding device (13) are performed simultaneously.

13. The yarn winding apparatus according to any one of Claims 5 to 12,
wherein
the yarn winding apparatus includes a plurality of winding devices (13) arranged in one direction, and
the doffer (60) is movable in the one direction in which the winding devices (13) are arranged.
Proposed additional method Claims

14. A method of operating a yarn winding apparatus **characterized by** the following steps:

winding a yarn (10) on a bobbin (45) to form a package (48), using a winding device (13); receiving the package (48) wound by the winding device (13) using a package receiving section (84) being arranged at a position lower than a position of the winding device (13); and
doffing the package (48) from the winding device (13) and convey the package to the package receiving section (84) using a doffer (60);

wherein the doffer (60) includes
a support member (65) supporting the package (48) doffed from the winding device (13) and supporting at least a part of the weight of the package (48) at an instant when the package (48) comes into contact with the package receiving section (84); and

driving the support member (65) to convey the package (48) supported by the support member (65) from the winding device (13) to the package receiving section (84) using a driving section (62).

15. The method according to Claim 14, wherein the support member (65) is interchanged according to a shape of the package.

16. The method according to Claim 14 or 15, wherein a rotation stopping section of the doffer (60) stops inertial rotation of the package (48) before the support member (65) starts supporting the package (48) by making contact with the package (48).

17. The method according to any one of Claims 14 to 16, wherein a restricting member (66) in the doffer (60) restricts a position of the package (48) in an axial direction of the package (48) while the package (48) is being conveyed.

18. The method according to any one of Claims 14 to 17, wherein
the package is loaded on a receptacle (82) in the package receiving section (84); and
the package (48) rolls down on a sloping member (81) toward the receptacle (82), and
the doffer (60) brings the package (48) into contact with the sloping member (81), and thereafter carries the package (48) to the receptacle (82) by causing the package (48) to roll down the sloping member (81).

19. The method according to Claim 18, wherein a roller member (67) of the doffer (60) is rolled on the sloping member (81).

20. The method according to any one of Claims 14 to 19, wherein
the winding device (13) includes a bobbin holding section (72) holding the bobbin (45), and
the doffer (60) includes an operating section (89) dismounting the package (48) from the bobbin holding section (72) while the support member (65) is in contact with the package (48).

21. The method according to any one of Claims 14 to 20, wherein a bobbin supplying section (50) supplies the bobbin (45), on which the yarn (10) is to be wound, to the winding device (13), and
the support member (65) is moved away from the winding device (13) and supplies the bobbin (45) from the bobbin supplying section (50) to the winding device (13) simultaneously.

22. The method according to any one of Claims 14 to 21, wherein
a plurality of winding devices (13) are arranged in one direction, and
the doffer (60) moves in the one direction in which the winding devices (13) are arranged.

FIG.1

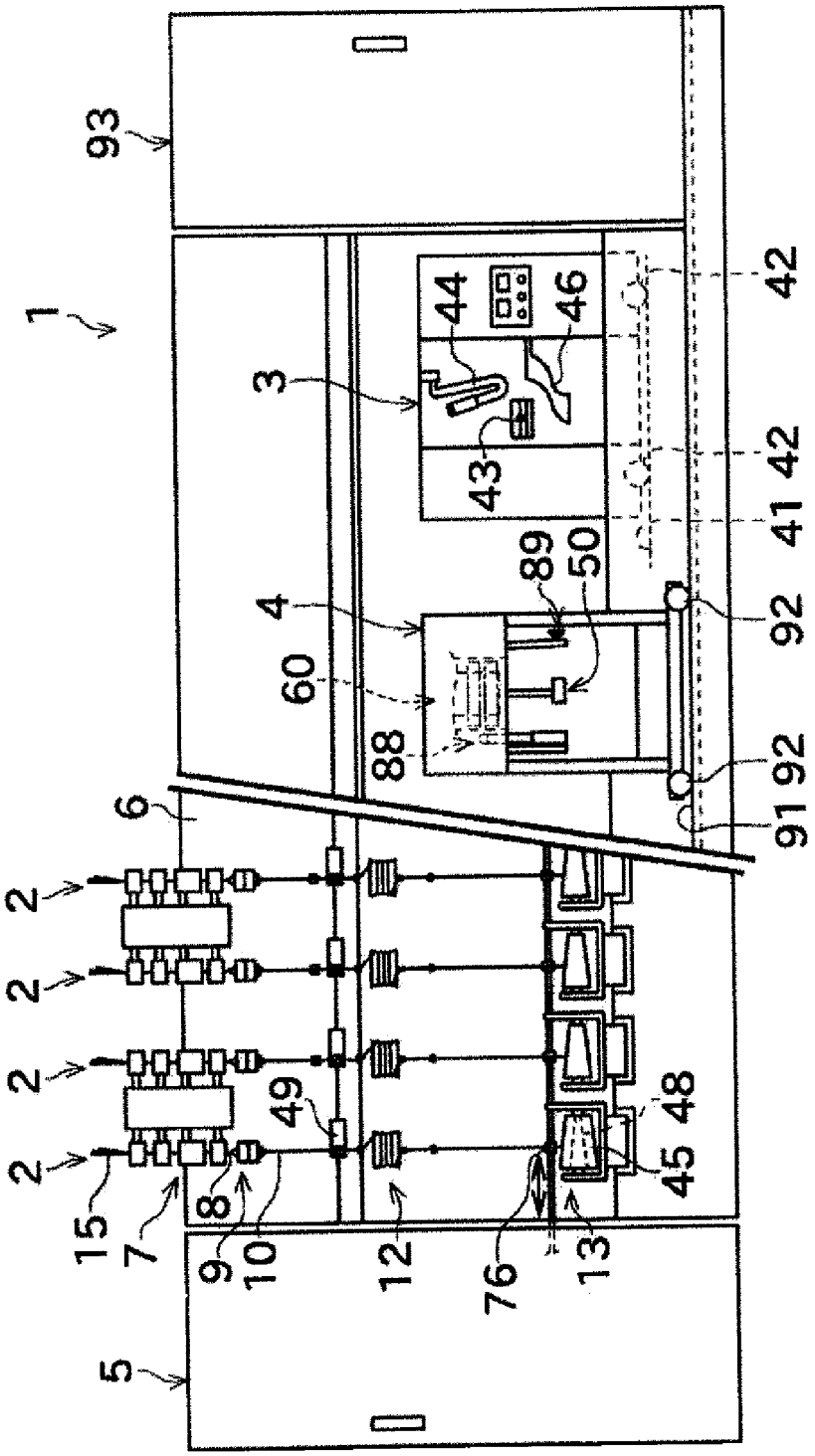


FIG.2

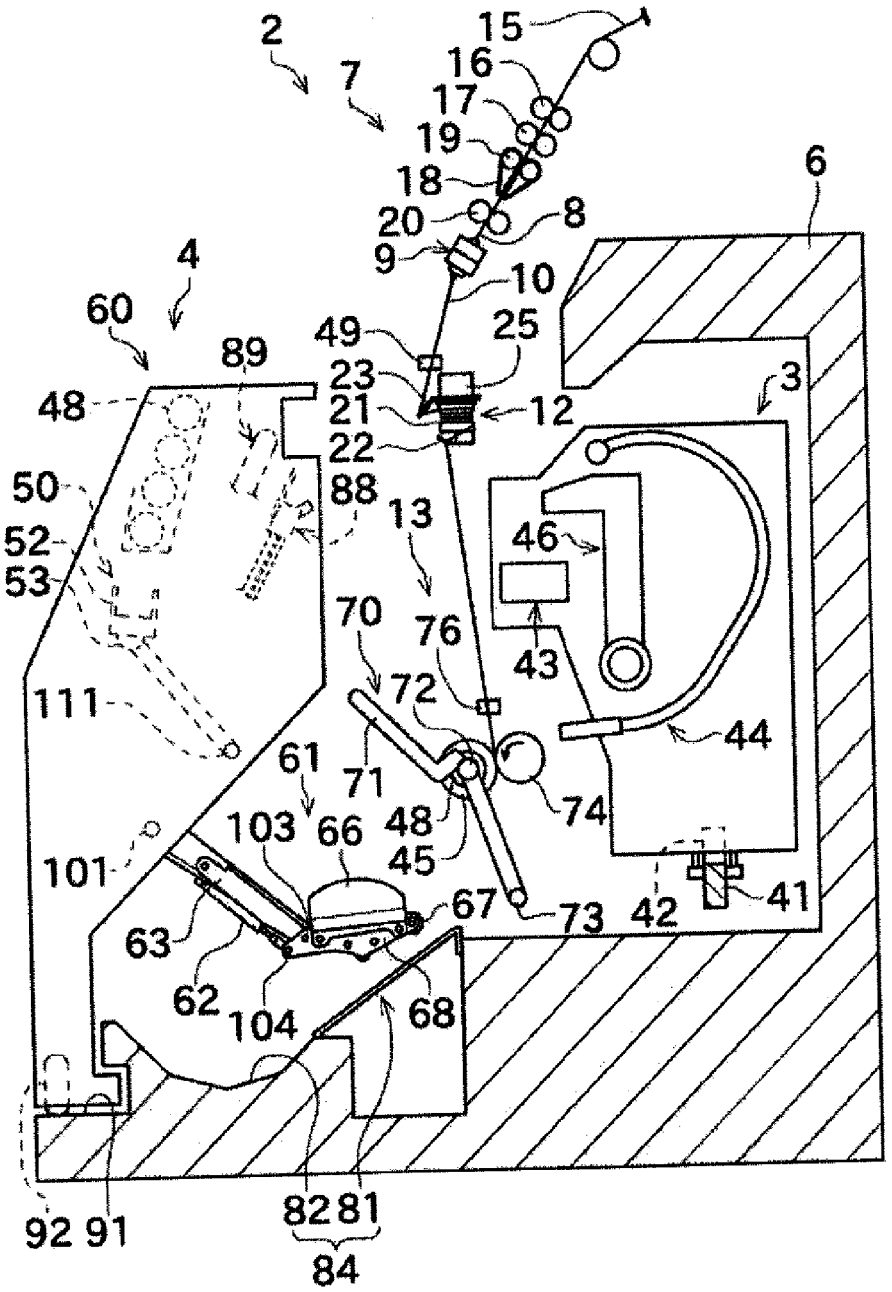

2
7
15
16
17
19
18
20
8
9
10
6
4
60
89
49
25
23
21
12
3
48
22
50
88
13
52
53
46
70
76
43
72
111
44
61
71
74
48
103
66
45
101
67
73
42
41
63
62
104
68
92
91
82
81
84

FIG.3

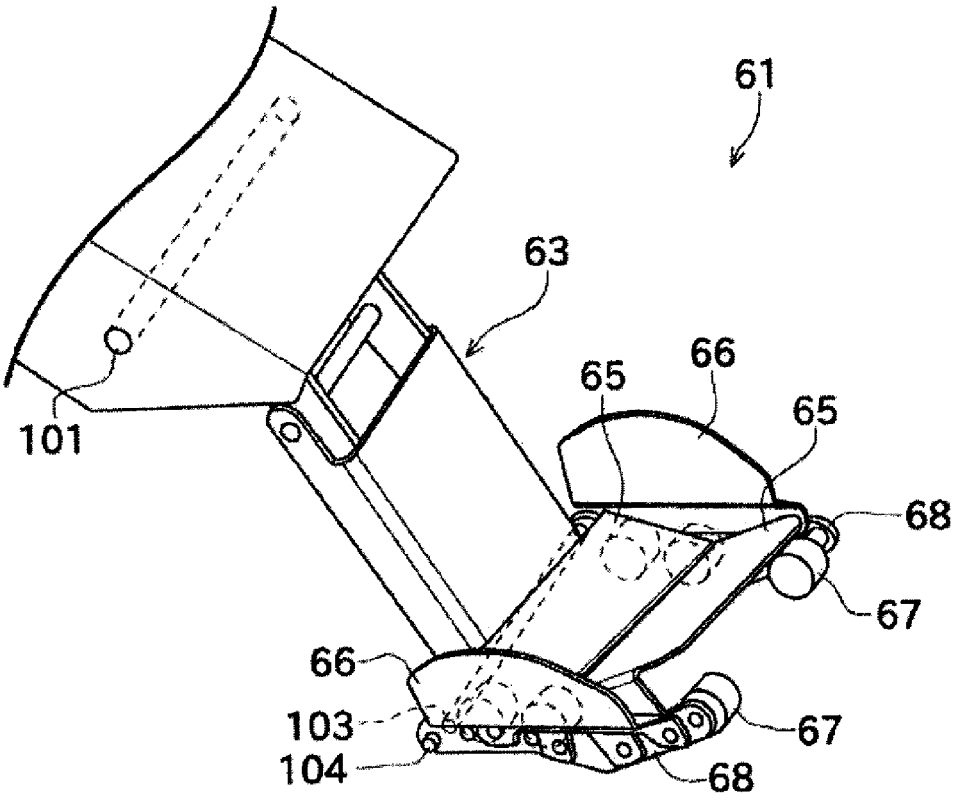


FIG.4A

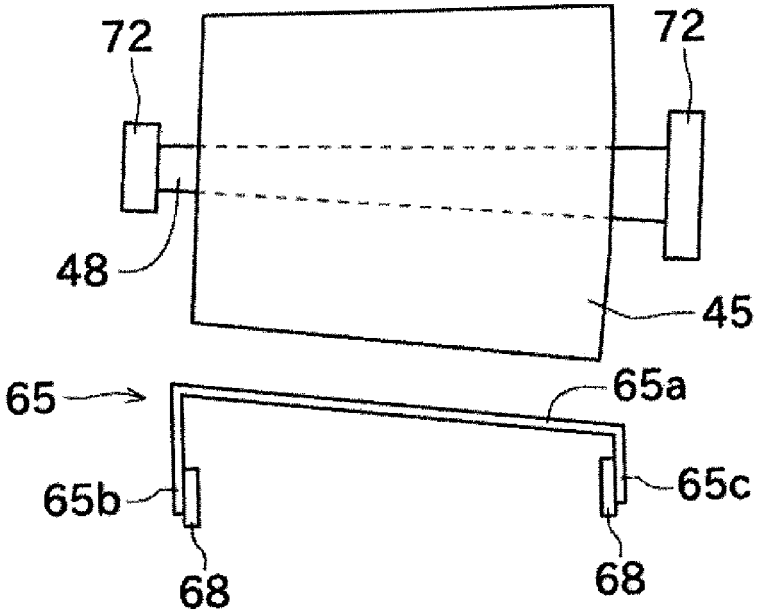


FIG.4B

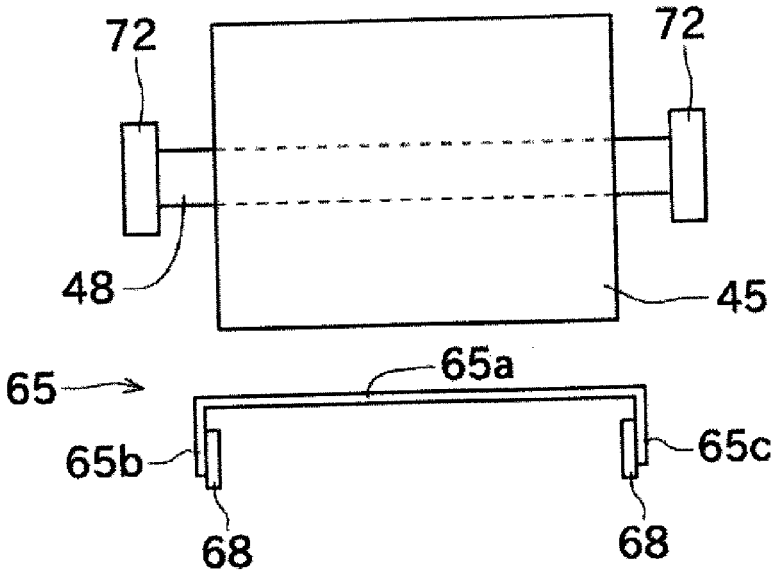


FIG.5

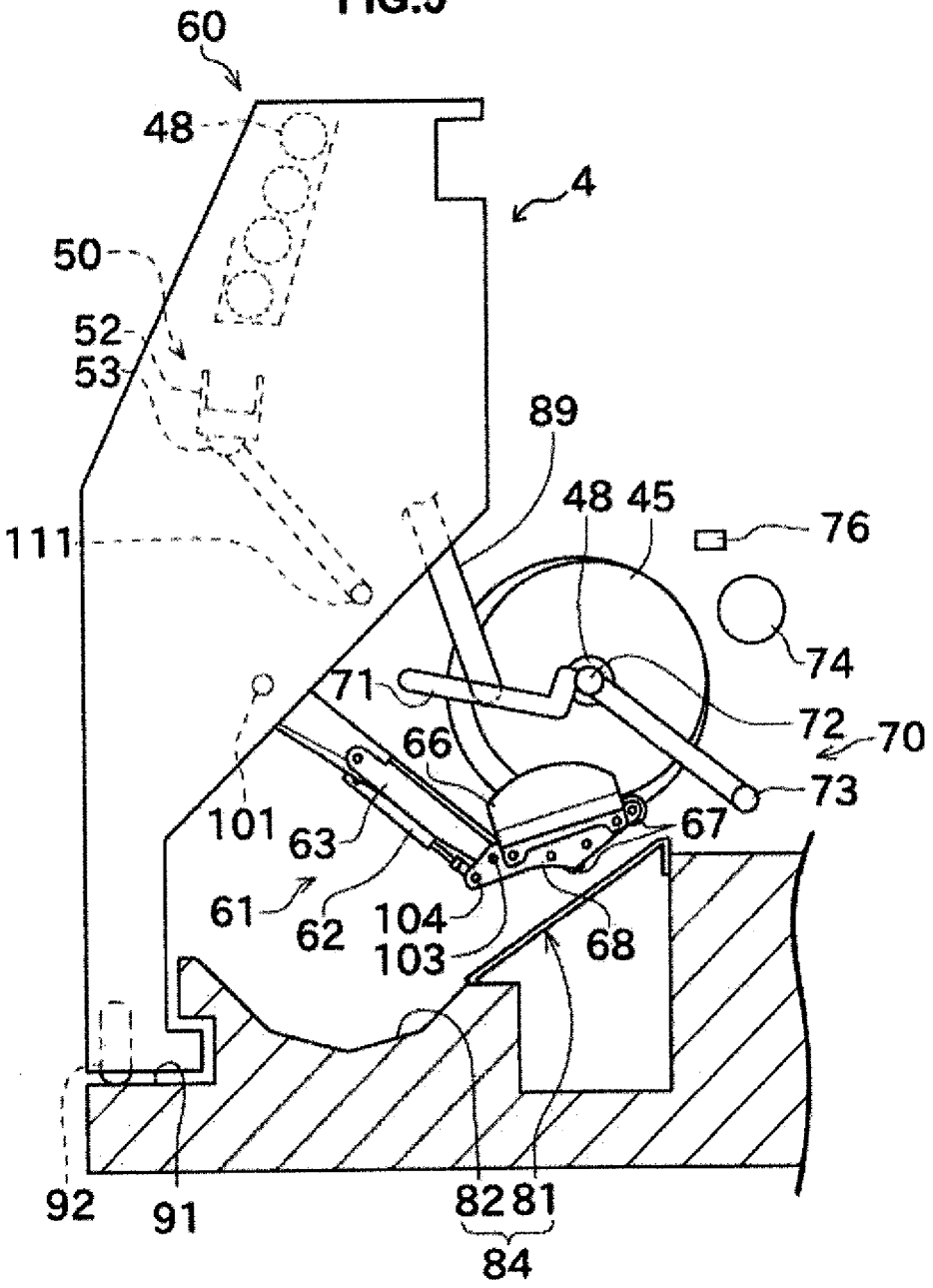
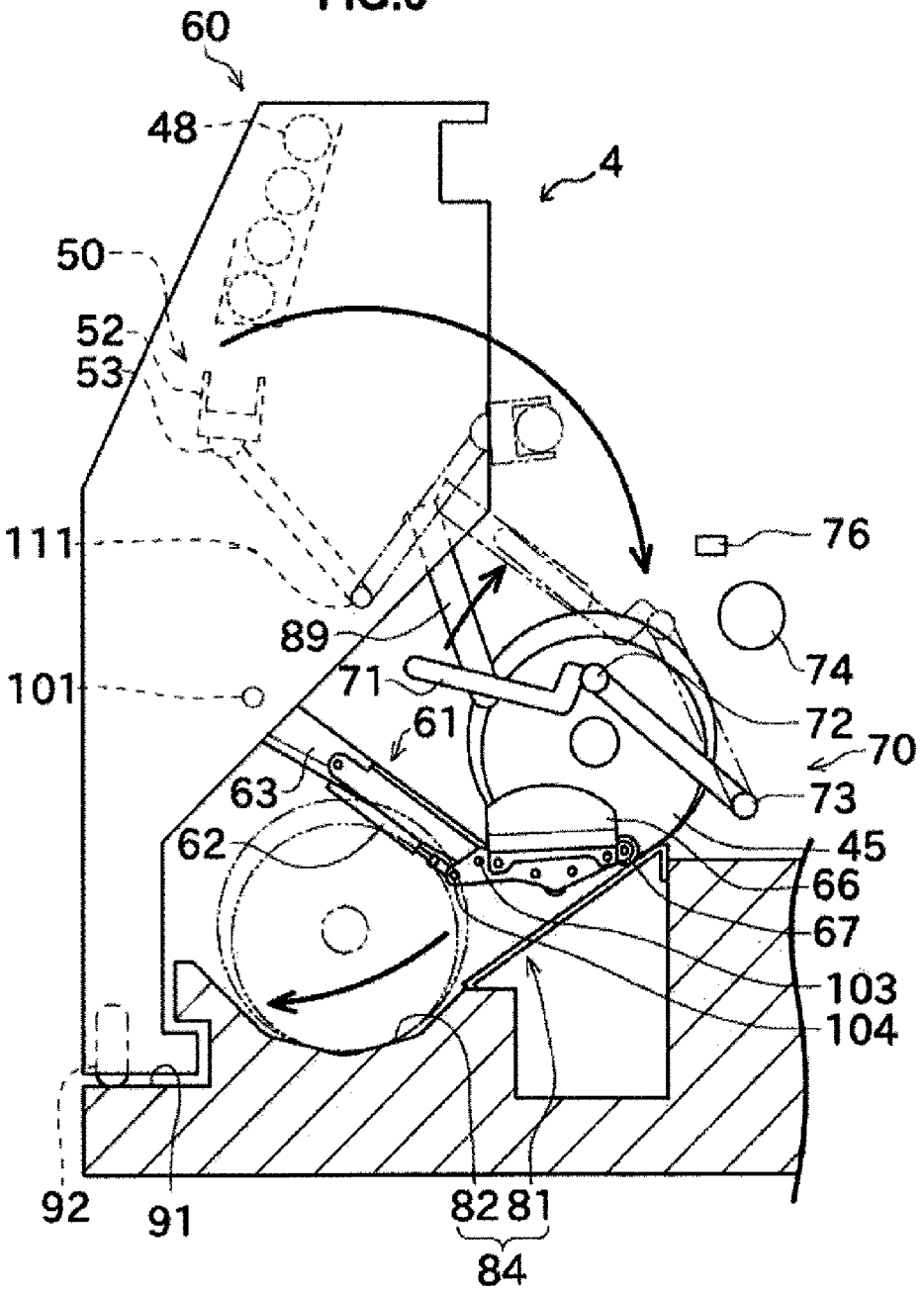

60
48
4
50
52
53
89
48 45
76
111
74
71
72
70
66
73
101
63
67
61
62
104
103
68
92
91
82 81
84

FIG.6


60
48
4
50
52
53
111
76
89
74
101
71
72
61
70
63
73
62
45
66
67
103
104
92
91
82
81
84

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP H9100066 B **[0002] [0003] [0005] [0006]**
- JP 2005220484 A **[0002] [0004] [0006] [0007] [0008]**