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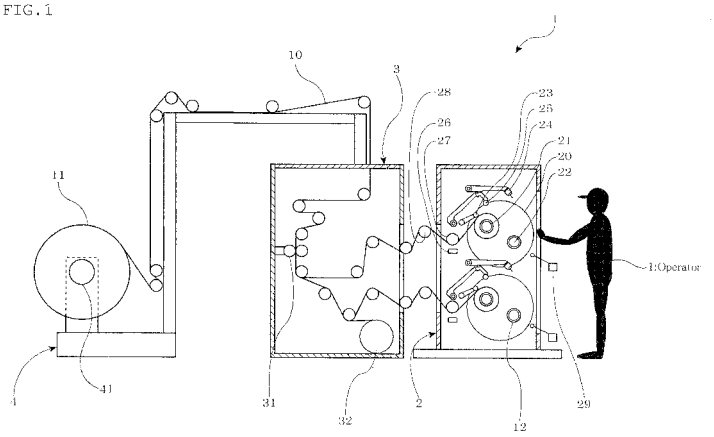
(54) **AUTOMATIC FILM WINDING DEVICE, SLITTING AND WINDING SYSTEM, AND METHOD OF PRODUCING ROLLED FILM**

(57) To provide an automatic film winding apparatus, a slit winding system and a method for producing a rolled film which can improve winding quality, is reduced in size and enables winding mechanisms to be arranged in multiple stages.

The automatic film winding apparatus includes winding shafts 21 and 22 for winding a film around a winding core 12, a turret 20 for pivotabaly supporting the winding shafts 21 and 22 in a rotatable manner, a touch roller 23 which presses the film to the winding shaft 22 when a predetermined amount of the film is wound by the winding shaft 21, and the turret 20 is rotated by a predetermined angle to allow the film to be hung on the winding shaft 22, a cutter 241 which cuts the film between the winding shaft 21 and the winding shaft 22, and a film affixing roller 25 which presses the film which has been cut to the winding shaft 22, and moves to the front end of the film while winding the film around the winding core 12 with the film being pressed.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The invention relates to an automatic film winding apparatus, a slit winding system, and a method for producing a rolled film. According to the automatic film winding apparatus, the slit winding system, and the method for producing a rolled film, it is possible to wind around a winding core, automatically or semi-automatically, a film which has been multiply slitted by a slitter or the like or a single wide film.

BACKGROUND ART

[0002] A plurality of films obtained by subjecting a long film to multiple slitting or a wide single film is wound around a winding core in a specified product length. In this case, in addition to the winding operation by means of an apparatus, additional operations are required. Examples of such additional operations include a lot of troublesome tasks such as installation of a winding core to a winding shaft, winding, cutting after the winding and removal of a rolled film from the winding shaft. Manual operation of these complicated works takes a prolonged period of time, and makes winding at an accurate position difficult. In addition, if a film winding apparatus does not have a turret mechanism, the above-mentioned additional tasks are performed while the winding apparatus is in the idling state. Under such circumstances, various turret-type automatic film winding apparatuses have heretofore been proposed to allow the additional tasks to be performed quickly and accurately.

[0003] For example, Patent Document 1 discloses a turret-type automatic film cutting and winding apparatus. This automatic cutting and winding apparatus is provided with an electrostatic charge-imparting means, a cutter (saw blade) and a pair of pressing means which enter the front and back of the cutter.

Patent Document 2 discloses a technology of an end-free winding apparatus for sheets. This end-free winding apparatus is provided with an endless belt, a pressing roller, and a front guide part or the like.

Furthermore, Patent Document 3 discloses a technology of a turret winding apparatus. This turret winding apparatus has a plurality of winding shafts with a cantilever structure and a fixed beam. The fixing and supporting member of this fixed beam supports the winding shaft at the winding operation position, thus allowing this turret winding apparatus to have an inboard structure.

Patent Document 1: JP-A-S62-215452
Patent Document 2: JP-A-H09-104550
Patent Document 3: JP-A-2001-97616

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0004] However, the technology using a saw blade as disclosed in Patent Document 1 has a problem that the cut surface cannot be linear. In addition, when cross cutting is performed by using a cutter such as a razor, the cutter is normally moved only in the film width direction. This cutting method has a problem that a film is cut curvedly at a position where the cutting blade is entered or removed.

In the technology disclosed in Patent Document 2, a belt or a plurality of rollers are used. By using them, a film which has once become in the free state is caught between a core (winding core) and a belt. Therefore, unless the position of the film in the free state is stable, a problem arises in which the film of the first layer tends to shift during film winding.

In the technology disclosed in Patent Document 3, although productivity increases due to the off-line set up, the apparatus is disadvantageous for the complicated structure thereof. In addition, further improvement of operability is required for automation.

That is, in the field of the automatic film winding apparatus, there is an increasing demand for realizing a reliable winding technology by further improving winding quality and reasonably solving the disadvantages associated with the apparatus.

[0005] In addition, if various functions are added to improve quality or productivity, a problem arises that an apparatus increases in size.

Furthermore, in order to efficiently wind a plurality of films which are obtained by multiply slitting by means of a slitter, it is required to provide a turret-type winding mechanism in multiple stages. Realizing a multiple-stage mechanism is difficult for an increased apparatus size or for other reasons.

For manufactures of an apparatus, it is required to further improve productivity, operability or the like of the automatic film winding apparatus, thereby enhancing the added value of the apparatus.

[0006] In view of the above-mentioned problems in conventional technologies, the object of the invention is to further improve winding quality and establish a highly reliable winding technology by reasonably solving the disadvantages associated with the conventional technologies, as well as to provide an automatic film winding apparatus and a slitting and winding system which can be reduced in size and arranged in multiple stages, and a method for producing a rolled film.

MEANS FOR SOLVING THE PROBLEM

[0007] To solve the above-mentioned problem, the automatic film winding apparatus of the invention comprises:

a winding shaft for winding a film around a winding core;
a touch roller for pressing the film which has been hung on the winding core to the winding core; and
a film affixing roller which presses the film to the winding core at a position on the downstream side of the touch roller, and moves to the front end of the film while winding the film with the film being pressed.

By this configuration, the film is effectively prevented from being slackened between the position of pressing by means of the touch roller and the front end of the film. As a result, the film can be wound with the film being closely adhered to the predetermined position of the winding core, whereby the winding quality is significantly improved.
Meanwhile, the above configuration can be applied to various automatic film winding apparatuses.
It is preferred that the automatic film winding apparatus have a cutter for cutting the film.

[0008] Furthermore, the automatic film winding apparatus of the invention comprises two or more winding shafts for winding a film around a winding core, a turret which moves the two or more winding shafts to a film winding position and a waiting position, and a cutter for cutting the film, which further comprises:

a touch roller which presses the film to the winding core of a second winding shaft of the two or more winding shafts when a predetermined amount of the film is wound by a first winding shaft at the film winding position of the two or more winding shafts, the turret is rotated by a predetermined angle and, the film is hung on the winding core of the second winding shaft of the two or more winding shafts which has moved to the film winding position;
the cutter which cuts, between the first winding shaft and the second winding shaft, the film which has been pressed by the touch roller; and
a film affixing roller which presses the film which has been cut to the winding core of the second winding shaft at a position on the downstream side of the touch roller, and moves to the front end of the film which has been cut while winding the film with the film being pressed.

[0009] By this configuration, the film is effectively prevented from being slackened between the position of pressing by means of the touch roller and the front end of the film. As a result, the film can be wound in the state where it is closely adhered to the predetermined position of the winding core, whereby the winding quality is significantly improved.
In the invention, the "front end" means not only the front end surface of the film which has been cut but also the area including the vicinity of the front end surface.
In the invention, the "winding quality" means a disadvantage that the winding start position (front end portion) is shifted in the direction to the shaft core of the winding shaft (hereinafter appropriately referred to as the "bad start"), wrinkles in the film or folded film corners and the like which occur during film winding.

[0010] Further, it is preferred that the automatic film winding apparatus be capable of removing the rolled film from the first winding shaft which is at the waiting position and setting the winding core to the first winding shaft while winding a film by the second winding shaft.
Due to such a configuration, removal of the rolled film or installation of a new winding core can be performed during film winding operation. As a result, operation rate of the apparatus can be improved.

[0011] Further, it is preferred that the automatic winding apparatus comprise two or more winding mechanisms which have the touch roller and the film affixing roller.
Due to such a configuration, production capacity can be enhanced effectively, and adaptation to various specifications becomes possible. As a result, the additional value of the apparatus can be improved.
Normally, the winding mechanisms are respectively provided with a cutter, but the configuration is not limited thereto. For example, a configuration in which a plurality of winding mechanisms shares a common cutter may be possible.
In addition, each winding mechanism normally has a turret. However, the configuration is not limited thereto.

[0012] Further, it is preferred that the automatic film winding apparatus have a configuration in which the touch roller has arms for a touch roller which rotatably support the touch roller, the cutter has a pair of arms for a cutter which rotatably supports the cutter, the film affixing roller has a pair of arms for a film affixing roller which rotatably supports the film affixing roller, the pair of arms for a film affixing roller are located between the pair of arms for the cutter, and the two or more arms for a touch roller are located between the pair of arms for a film affixing roller.
Due to such a configuration, the apparatus can have a reduced size since the arms do not interfere with each other.

[0013] It is preferred that the apparatus have an air bleeding mechanism.
Due to such a configuration, a disadvantage that air enters between the films can be prevented. As a result, the apparatus can be reduced in size.

[0014] It is preferred that the air bleeding mechanism be a touch roller.
Due to such a configuration, since the touch roller also functions as the air bleeding mechanism, separate provision of an air bleeding mechanism will be unnecessary.

[0015] It is preferred that the automatic film winding apparatus have a film carrier roller for supplying the film to the winding shaft.
Due to such a configuration, the film can be carried smoothly.

[0016] Furthermore, it is preferred that the automatic

film winding apparatus have a holding means which holds the film by pressing the film to the film carrier roller.
Due to such a configuration, occurrence of any further bad starts can be suppressed reliably.

[0017] It is preferred that the holding means be a nip bar for pressing the film to the film carrier roller.
Due to such a configuration, the film can be held reliably and the apparatus can have a simple structure.

[0018] It is preferred that the angle of the contact surface of the film carrier roller and the film (film holding angle) be 90° to 160°.
Due to such a configuration, the film carrier roller can be rotated smoothly with the film.

[0019] It is preferred that the film contact surface of the film carrier roller be formed of a porous material or a slightly adhesive material.
Due to such a configuration, it is possible to eliminate weaving at the end surface of a wound product which is caused by the shift of the film in the lateral direction.

[0020] It is preferred that the automatic film winding apparatus be provided with a winding core positioning mechanism for positioning the winding core in the width direction of the film.
Due to such a configuration, it is possible to perform positioning of the winding core accurately within a short period of time. As a result, productivity or quality (center winding accuracy) can be improved.
The "center winding accuracy" means the degree of coincidence of the center of the winding core in the central axis direction thereof and the center of the widthwise direction of the rolled film.

[0021] It is preferred that the winding core positioning mechanism be provided with a bar material mounted such that it can move freely between the positioning position and the waiting position and a stopper movably mounted on the bar material.
Due to such a configuration, the automatic winding apparatus can be operated easily and can have a simple structure.

[0022] It is preferred that the automatic winding apparatus have a film tension control system.
Due to such a configuration, the tension of the film can be adjusted easily.

[0023] Furthermore, in the film tension control system, it is preferred that the winding shaft be a friction shaft and that the winding shaft be rotated in the winding direction with such a torque that enables the winding core to slide against the film which is pressed by the touch roller in the state where the film affixing roller is pressing the front end of the film.
Due to such a configuration, if a slight degree of film slackening remains between the touch roller and the film affixing roller, the slackening can be eliminated. As a result, the winding quality can be further improved.

[0024] Furthermore, it is preferred that the cutter be provided with a guide member and a cutting blade which moves along the guide member and that the film which has been imparted with tension by the abutment of the guide member be cut by the cutting blade.
Due to such a configuration, a disadvantage that the film is cut curvedly at the side where the cutting blade is entered or removed can be eliminated, and linear cutting can be realized. In addition, a trouble such as adherence of resist chips can be eliminated.

[0025] It is preferred that the automatic film winding apparatus be provided with a retaining mechanism which retains the film which has been wound around the winding core by the film affixing roller to the surface of the winding core.
Due to such a configuration, a trouble that the front end of the film peels off from the surface of the winding core before the films overlap one on another can be avoided reliably.
The retaining means include adsorption by static electricity, air spraying, adhesion by a double coated adhesive tape, an adhesive or the like.

[0026] It is preferred that the film affixing roller be provided with a rotating shaft which is rotatably provided, a pair of arms provided such that they oppose to the rotating shaft, a pair of urging arms which are respectively connected rotatably to the front end of the pair of arms and urged in the direction of the rotating shaft, and a roller which is pivotably installed on the front end of the pair of urging arms in a rotatable manner.
Due to such a configuration, the apparatus can be reduced in size and can have a simple structure.

[0027] In order to attain the object of the invention, the slit winding system of the invention is provided with a slitter which cuts a film into a predetermined width and the automatic film winding apparatus according to any one of the above-mentioned claims 1 to 20 for winding up the film which has been supplied from the slitter.
As mentioned above, the invention is effective as the slit winding system, and can improve both quality and productivity.

[0028] It is preferred that at least one of the slitter and the automatic winding apparatus be movably provided.
Due to such a configuration, for example, during maintenance, the automatic film winding apparatus can be moved easily. In addition, during production, it is possible to shorten the distance between the slitter and the automatic film winding apparatus. Due to the reduction in distance, the carrying span is reduced, thus eliminating defects such as step-like irregularities of a rolled film.
In the invention, the "step-like irregularities" means unevenness on the end surface of a rolled film in the form of steps or convexes and concaves.

[0029] In order to attain the above-mentioned object, the method for producing a rolled film of the invention, in which a film is wound around a winding shaft, comprises:

a step in which the film is hung on a winding core of the winding shaft;
a step in which a touch roller presses the film to the winding core of the winding shaft; and
a step in which a film affixing roller presses the film

to the winding core at a position on the downstream side of the touch roller, and moves to the front end of the filmwhile winding the film with the film being pressed.

As mentioned above, the invention is advantageous as a method for producing a rolled film, and slackening of a film between the pressing position by a touch roller and the front end of the film can be effectively prevented. Due to such a configuration, winding can be performed with the film being closely adhered to a predetermined position of the winding core. As a result, winding quality can be significantly improved.

[0030] In order to attain the above-mentioned object, the method for producing a rolled film of the invention, in which a film is wound around a plurality of winding shafts by turns, comprises:

a step in which a first winding shaft stops rotating when a predetermined amount of the film is wound around the winding core of a first winding shaft;
a step in which a turret holding the plurality of winding shafts rotates by a predetermined angle, allowing the film to be hung on the winding core of a second winding shaft, with the film being held by a carrier roller;
a step in which the touch roller presses the film to the winding core of the second winding shaft, and the cutter cuts the film between the first winding shaft and the second winding shaft;
a step in which the film affixing roller presses the film to the winding core of the second winding shaft at a position on the downstream side of the touch roller; and
a step in which the film affixing roller moves to the front end of the film with the film being pressed.

As mentioned above, the invention is advantageous as a method for producing a rolled film, and slackening of a film between the pressing position by a touch roller and the front end of the film can be effectively prevented. Due to such a configuration, winding can be performed with the film being closely adhered to a predetermined position of the film. As a result, winding quality can be significantly improved.

[0031] It is further preferred that the second winding shaft formed of a friction shaft rotate in the winding direction with a torque sufficient to remove slackening of the film which has been pressed by the touch roller in the state where the film affixing roller is pressing the front end of the film.

Provision of this step leads to further improvement in quality.

[0032] Further, it is preferred that the method for producing a rolled film of the invention be provided with a step in which the touch roller and the film affixing roller stop pressing the film when the carrier roller stops holding the film, the second winding shafts rotates in the winding direction at a predetermined winding torque, the film is wound around the winding core of the second winding shaft, and the front end of the film approaches an overlapping position, and

a step in which the touch roller presses the film to the winding core of the second winding shaft and the second winding shaft rotates in the winding direction at a predetermined winding up torque when the front end of the film passes the overlapping position.

Due to the provision of this step, occurrence of a disadvantage such as a bad start can be prevented more reliably.

As mentioned above, according to the automatic film winding apparatus, the slit winding system and the method for producing a rolled film of the invention, not only the winding quality can be improved but also the apparatus can be reduced in size and can be arranged in multiple stages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033]

FIG. 1 is a schematic cross sectional view of a slit winding system according to one embodiment of the invention as viewed from the lateral direction;
FIG. 2 is a schematic front view of an automatic film winding apparatus according to one embodiment of the invention;
FIG. 3 is a schematic view of a film affixing roller of an automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line A-A;
FIG. 4 is a schematic view of a touch roller of an automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line B-B;
FIG. 5 is a schematic view of a cutter provided with a guide of the automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line C-C;
FIG. 6 is a schematic view of a winding core positioning means of the automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line D-D;
FIG. 7 is a schematic enlarged cross sectional view of the film carrier roller in the automatic film winding apparatus according to one embodiment of the invention for explaining the holding angle;
FIG. 8 is a schematic cross sectional view of the essential parts of the automatic film winding apparatus according to one embodiment of the invention as viewed from the lateral direction for explaining each operation;

FIG. 9 is a schematic enlarged cross sectional view of the essential parts of the automatic film winding apparatus according to one embodiment of the invention as viewed from the lateral direction for explaining the effects of the film affixing roller;
FIG. 10 is an enlarged view of the essential parts of the automatic film winding apparatus according to one embodiment of the invention as viewed from the lateral direction for explaining the effects of the low-speed rotation with a torque sufficient to remove slackening; in which (a) is a cross-sectional view before removal of slackening and (b) is a cross-sectional view after removal of slackening; and
FIG. 11 is a schematic flow chart for explaining the method for producing a rolled film according to one embodiment of the invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0034] An explanation is made on one embodiment of the slit winding system and the automatic film winding apparatus according to the invention.

(Slit Winding System)

[0035] FIG. 1 shows a schematic cross sectional view of the slit winding system according to one embodiment of the invention as viewed from the lateral direction.
In FIG. 1, a slit winding system 1 is formed of an automatic film winding apparatus 2 and a slitter 3. The automatic film winding apparatus 2 is connected to a web feeding apparatus 4.
The web feeding apparatus 4 has a feeding shaft 41 on which a web 11 is installed, and supplies a film 10 to the slitter 3. The slitter 3 has a slitting part 31 which cuts the film 10 which has been supplied from the web feeding apparatus 4, and an edge winding part 32 which winds the edge portion of the film 10. This slitter 3 supplies the films 10 which have been cut to the automatic winding apparatus 2. This automatic film winding apparatus 2 simultaneously winds the films 10 which have been cut and supplied from the slitter 3 (two films in this embodiment).
In this embodiment, the automatic film winding apparatus 2 and the slitter 3 are separately provided. However, the invention is not limited to this configuration. For example, the film automatic winding apparatus 2 may be incorporated into the slitter 3 as part of the slitter 3.
[0036] Although not shown, the slit winding system 1 has a winding apparatus moving mechanism which allows the automatic film winding apparatus 2 to be movable. In addition, the winding apparatus moving mechanism has an LM guide, a motor, a gear, a chain or the like, and allows the automatic film winding apparatus 2 to move freely. Due to the provision of the winding apparatus moving mechanism, it is possible to move the automatic film winding apparatus 2 freely during maintenance. Furthermore, during production, the distance between the slitter 3 and the automatic film winding apparatus 2 can be shortened. Due to the shortened distance, the carrying span is reduced. As a result, step-like irregularities or other disadvantages can be suppressed. In addition, connection to other slitters or modification of the slit constant can be performed easily.
The configuration of the winding apparatus moving mechanism is not limited to that mentioned above. The winding mechanism moving mechanism can have various configurations. For example, it may have a configuration in which a guide, a ball screw, a motor or the like is used, or a cylinder is used instead of a motor. Furthermore, it may have a configuration in which a guide, a ball screw or the like is provided, and the ball screw is manually turned. In respect of operability or safety, a configuration using a guide, a ball screw, a motor or the like is preferable.

(Film Automatic Winding Apparatus)

[0037] FIG. 2 is a schematic front view of an automatic film winding apparatus according to one embodiment of the invention.
In FIG. 2, for the convenience of easy understanding of the condition of the film 10 which is being wound, a cutter 24 provided with a guide, a film affixing roller 25, a winding core positioning means 29 or the like, which will be mentioned later, are not shown.
The automatic film winding apparatus 2 is provided with a turret 20, a first winding shaft 21, a second winding shaft 22, a touch roller 23, a cutter 24 provided with a guide, a film affixing roller 25, a nip bar 26, a first film carrier roller 27, a second film carrier roller 28, a winding core positioning means 29 or the like.
When winding a single film or a plurality of films which are adj acent to each other, only one set of the winding mechanism is provided. This winding mechanism has a pair of the opposing turrets 20, the touch roller 23, the cutter 24 provided with a guide as a cutting means, the film affixing roller 25 or the like. The above-mentioned winding mechanism is provided at two locations if the films are wound alternatively in two separated groups. Due to such a configuration, troubles that the edge of each of the multiply slitted films gets scratches or the film gets caught in adjacent winding rolls can be avoided.
The automatic film winding apparatus 2 of this embodiment has the two-stage winding mechanisms which are provided in the vertical direction. This winding mechanism has a pair of the opposing turrets 20, the touch roller 23, the cutter 24 provided with a guide as a cutting means, the film affixing roller 25 or the like. Due to such a configuration, the film 10 can be wound simultaneously in each of the winding mechanisms, whereby production ability can be enhanced effectively. In addition, due to the adaptability to various specifications, the added value of the apparatus can be improved.
[0038] Though not shown, the automatic film winding apparatus 2 has, on the both sides thereof, a motor for

driving, a gear box, a pulley or the like for driving are provided to allow the first winding shaft 21, the second winding shaft 22 and the turret 20 to rotate. On the left side thereof, a display panel 202, an operation panel 203, and a control device (not shown) for controlling each of the driving means are provided.

<Turret>

[0039] The turret 20 is in the form of a pair of opposing discs, and each turret is rotatably secured to a pivotable support plate 201. Between the pair of turrets 20, the first winding shaft 21 and the second winding shaft 22 are pivotably installed. Due to such a configuration, for example, if the turret 20 is rotated by 180°, the first winding shaft 21 at the film winding position is moved to the waiting position, and the second winding shaft 22 at the waiting position is moved to the film winding position.

Further, it is preferred that the turrets have a configuration in which the rolled film 10 is removed from the first winding shaft 21 at the waiting position while the film is wound around the second winding shaft 22 and the winding core 12 is installed in the first winding shaft 21. Specifically, the right end of each of the first winding shaft 21 and the second winding shaft 22 is supported by the turret 20 on the right through a rotatable bearing 212, and the left end of each of the first winding shaft 21 and the second winding shaft 22 is rotatably supported by the turret 20 on the left by a switching bearing 213 provided at a position corresponding to the rotatable bearing 212. The switching bearing 213 stops supporting the left end of each of the first winding shaft 21 or the second winding shaft 22 when these shafts are caused to rotate in the front direction. Due to such a configuration, removal of the rolled film 10 or the installation of a new winding core 12 can be performed easily during the film winding operation. As a result, the operation rate of the apparatus can be improved.

In this embodiment, two winding shafts are provided in the turret. The number of the winding shafts is, however, not limited to two. Three or more winding shafts may be provided, for example. If four winding shafts are provided in the turret, the turret is rotated by 90°. Due to this rotation, each winding shaft moves, and the winding shaft, which has moved to the film winding position, winds up the film. As a result, the film can be wound continuously. The turret cannot be necessarily provided if only one winding shaft is used.

<Winding Shaft>

[0040] The first winding shaft 21 and the second winding shaft 22 wind the film 10 around the winding core 12. A film tension control system may preferably be provided. By the provision of the film tension control system, the tension of the film 10 can be adjusted easily.

The first winding shaft 21 and the second winding shaft 22 are friction shafts each having an expanded packing 211. Due to such a configuration, a rotation torque to be transmitted to the winding core 12 can be controlled. In addition, as mentioned later, if a slight degree of film slackening remains between the touch roller 23 and the film affixing roller 25, such slackening can be removed. Normally, it is preferred that the winding speed of the film 10 be 50 m/min or more. The winding speed is, however, not limited thereto.

The film tension control system used is not limited to the above-mentioned expanded packing 211. For example, a simple air shaft or air friction shaft can be used. Other expansion shafts may also be used.

[0041] The maximum width dimension which allows the winding core 12 to be installed is set as L. Therefore, the automatic film winding apparatus 2 can wind the film 10 of which the maximum width dimension is L.

In this embodiment, the film 10 is wound by the right side portion of the first winding shaft 21 (second winding shaft 22) in the upper stage and the left side portion of the first winding shaft 21 (second winding shaft 22) in the lower stage. The manner of winding is, however, not limited thereto. For example, although not shown, three films 10 can be simultaneously wound by the right side portion and the left side portion of the first winding shaft 21 (second winding shaft 22) in the upper stage and the central portion of the first winding shaft 21 (second winding shaft 22) in the lower stage. That is, the quantity of the winding core 12, the installation position of the winding core 12, and the film width can be set freely within the maximum dimension L.

<Film Affixing Roller>

[0042] FIG. 3 is a schematic view of a film affixing roller of the automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line A-A. In FIG. 3, the film affixing roller 25 is provided with a roller 251, an urging arm 252, an arm 253, an air cylinder 254, a rotating shaft 255 and a driving arm 256.

The both ends of the rotating shaft 255 are rotatably supported by the opposing pivotable support plates 201, and the driving arm 256 is fixed to the front end on the right side. The front end of this driving arm 256 is connected to an air cylinder for rotating (not shown).

[0043] The pair of the arms 253 is a hook-shaped plate. In the opposing state, the roots thereof are fixed to the rotating shaft 255. This arm 253 and the urging arm 252 are the arms for the affixing roller as the film affixing roller moving mechanism, and rotatably support the film affixing roller 25.

To the front end of the arm 253, the urging arm 252, which is in the concave shape with the both ends thereof being curved, is rotatably connected, and is urged towards the rotating shaft 255 by the air cylinder 254. The waiting position of this urging arm 252 is a position at which it is almost perpendicular to the arm 253. The roller 251 which has been secured to the urging arm 252 presses the film

10 on the winding core 12 when the arm 253 rotates in the affixing direction.

[0044] The roller 251 is a free-roller having a length of L, with the top surface being formed of a resin, rubber or the like. This roller 251 is rotatably secured to the front end of the opposing pair of urging arms 252.

By allowing the film affixing roller 25 to have the above-mentioned configuration, the apparatus can have a reduced size and a simple structure, leading to the reduction in manufacturing cost.

This film affixing roller 25 presses the cut film 10 to the winding core 12 of the second winding shaft 22 at a position on the downstream side of the touch roller 23, for example. The film affixing roller 25 moves to the front end of the film 10 which has been cut, while winding the film 10 which has been cut around the winding core 12 with the film being pressed.

<Touch Roller>

[0045] FIG. 4 is a schematic view of a touch roller of the automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line B-B.

In FIG. 4, the touch roller 23 is provided with a roller 231, an arm 232, a rotating shaft 233 and a driving arm 234.

The rotating shaft 233 is a shaft in which a key way is formed. The both ends of the rotating shaft 233 are rotatably supported by the opposing pivotably support plates 201.

The driving arm 234 is fixed to the front end on the right side of the rotating shaft 233. The front end of this driving arm 234 is connected to an air cylinder for driving (not shown). The roots of the pair of the arms 232, which are in the opposing state, are fixed to the rotating shaft 233 through a key (not shown). The roller 231 is a free-roller with the top surface being formed of a resin, rubber or the like. This roller 231 is rotatably secured to the front end of the opposing pair of arms 232.

The length of the roller 231 corresponds to the width of the film 10 to be wound. In addition, the roller 231 is installed at a position corresponding to the film 10 to be wound by the arm 232.

[0046] If the film 10 having a different width is wound with a product change, the position of the arm 232 is adjusted by means of the roller 231 having a length corresponding to the width of the film. By doing this, it is possible to meet the product change easily. The length of the roller 231 can be appropriately adjusted according to the width of the film 10 to be wound. The length of the roller 231 may be slightly longer or shorter than the width of the film 10. In respect of air bleeding, it is preferred that the length of the roller 231 be slightly longer than the width of the film 10. in respect of prevention of weaving, it is preferred that the length of the roller 231 be slightly shorter than the width of the film 10. That is, the length of the roller 231 can be appropriately selected according to the type or thickness of the film 10 to be wound.

The touch roller 23 presses the film 10, which has been hung on the winding core 12 of the second winding shaft 22, to the winding core 12 of the second winding shaft 22, when, for example, the winding of the film 10 by the first winding shaft 21 is completed and the turret 20 is rotated by a predetermined angle (180°).

[0047] Furthermore, it is preferred that the automatic film winding apparatus 2 have an air bleeding mechanism. Due to the provision of the air bleeding mechanism, a trouble that air enters between the films 10 can be prevented.

In the automatic film winding apparatus 2 in this embodiment, the touch roller 23 is used as the air bleeding mechanism. Due to such a configuration, since the touch roller 23 functions also as the air bleeding mechanism, the need for providing a bleeding mechanism can be eliminated. As a result, reduction in size of the apparatus can be realized.

The air bleeding mechanism is not limited to the above-mentioned mechanism. Any mechanism can be used insofar as it can perform air bleeding. For example, the near roll winding method in which winding is performed with the roller being in the vicinity of, not in contact with, the film, or the touch roll winding method in which winding is performed with the touch roller 23 being completely in contact with the film.

If the film 10 has no problems in its properties, it is preferable to select the touch rolling method in which the touch roller 23 is used since it is an effective way to prevent air entertainment. The touch roller 23 is particularly preferable since, in addition to air bleeding, the touch roller 23 has a function of pressing the film, and is capable of preventing the film 10 from shifting during cutting.

<Cutter provided with a Guide>

[0048] FIG. 5 is a schematic view of a cutter provided with a guide of the automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line C-C.

In FIG. 5, the cutter 24 provided with a guide is provided with a cutting blade 241, a rodless cylinder 242, a holding member 243, a guide bar 244, an arm 245, a rotating shaft 246 and a driving arm 247.

The both ends of the rotating shaft 246 are rotatably supported by the pivotable support plate 201 which are opposing, and the driving arm 247 is fixed to the front end on the right side of the rotating shaft. The front end of the driving arm 247 is connected to an air cylinder for rotating (not shown).

The pair of arms 245 is a plate with the front end being curved. In the opposing state, the roots thereof are fixed to the rotating shaft 246. The rodless cylinder 242 is installed on the front end of the arms 245 through a supporting member. A connecting member is installed on the front end of each of the arms 245 through the supporting member. Two guide bars 244 are installed on

each of the connecting member in such a manner that they are opposing with a prescribed interval.

[0049] A cutting blade 241 is installed on the rodless cylinder 242 through the holding member 243. This cutting blade 241 can cut the film 10 having a maximum width dimension of L. Furthermore, the cutting blade 241 moves through a predetermined gap between the two guide bars 244. That is, when the arms 245 are rotated, the two guide bars 244 abut the film 10, and by this abutment, the film 10 is imparted with an appropriate tension. The cutting blade 241 cuts the film 10 which has been imparted with an appropriate tension. By doing this, a trouble can be avoided that the film is cut in a curved manner at a position where the blade 241 is entered or removed, thus realizing linear cutting. In addition, a trouble such as adherence of resist chips can be avoided.

This cutter 24 provided with a guide cuts the film 10 which has been hung on the first winding shaft 21 and the second winding shaft 22 between the first winding shaft 21 and the second winding shaft 22.

[0050] As mentioned above, the cutter 24 provided with a guide has a pair of arms 245 which are rotatably supported, and the distance between the pair of arms is taken as L_0 (see FIG. 5).

Here, the film affixing roller 25 has a pair of arms 253 which are rotatably supported, and the maximum external dimension of the arms 253 including the air cylinder 254 is L_1 (see FIG. 3), and L_0 is larger than L_1. Therefore, the pair of arms 253 of the film affixing roller 25 is accommodated between the pair of arms 245 of the cutter 24 provided with a guide.

The distance between the arms 253 is L_2 (see FIG. 3), and the distance between the pair of arms 232 which pivotably supports the touch roller 23 is shorter than the distance between the pair of arms 253 (L_2). Therefore, the pair of arms 232 of the touch roller 23 is accommodated between the pair of arms 253 (see FIG. 4).

Therefore, due to the above-mentioned configuration, the automatic film winding apparatus 2 of this embodiment can be reduced in size since the arms 245, 253 and 232 do not interfere with each other.

<Winding Core Positioning Means>

[0051] FIG. 6 is a schematic view of a winding core positioning means of the automatic film winding apparatus according to one embodiment of the invention, in which (a) is a front view and (b) is a cross-sectional view taken along the line D-D.

In FIG. 6, the winding core positioning means 29 is provided with a stopper 291, a knob 292, a sliding bar 293, a connecting plate 294 and a bearing 295.

The stopper 291 is in an approximate rectangular cylindrical shape, and is slidably installed on the sliding bar 293. The knob 292 with a male screw being projectably provided at the lower part thereof penetrates the stopper 291. The stopper 291 is fixed to the sliding bar 293 when the knob 292 is tightened, and becomes slidable when the knob 292 is loosened.

The both ends of the sliding bar 293 are connected to the bearing 295 through the connecting plate 294. Each of the pair of the bearings 295 is screwed to the pivotable support plate 201. The bearing 295 has a rotating angle of about 180°, and can be freely rotated within this range. An operator rotates the sliding bar 293 between the waiting position (the position which is obliquely below as viewed from the front side) and the positioning position (the position which is obliquely above as viewed from the back side).

[0052] The stopper 291 of the winding core positioning means 29 is normally in the waiting position, and avoids a trouble that it contacts the rolled film 10. When positioning of the winding core 12 is performed, the stopper 291 is rotated to the positioning position, where the end surface of the winding core 12 abuts the stopper 291, whereby the winding core 12 can be positioned. In this embodiment, the abutting surface of the stopper 291 is set at a position which is away from the center of the shaft with a distance of L_3 (see FIG. 2).

By doing this, it is possible to position the winding core 12 accurately in a short period of time, whereby the productivity or quality (winding accuracy in center) can be improved. By allowing the winding core positioning means 29 to have the above-mentioned configuration, it can be operated easily and can have a simplified structure. As a result, the manufacturing cost can be reduced.

In the configuration of this embodiment, an operator sets the winding core 12. The configuration is, however, not limited to this. For example, the winding core 12 may be automatically set at a predetermined position above the winding shafts 21 and 22 by means of a winding core positioning mechanism (not shown) .

<Film Carrier Roller>

[0053] It is preferred that the automatic film winding apparatus have a film carrier roller which supplies the film 10 to the winding shafts 21 and 22. Due to the provision of the film carrier roller, the film 10 can be carried smoothly.

As shown in FIG. 1, the automatic film winding apparatus 2 of this embodiment is provided with a first film carrier roller 27 and a second film carrier roller 28 for each of the pair of the turrets 20. The first film carrier roller 27 and the second film carrier roller 28 supply the film 10 to the first winding shaft 21 or the second winding shaft 22.

The journal diameter of the film carrier rollers 27 and 28 is 10 to 25 mm. The journal diameter means the axial diameter of the roller. The optimum journal diameter is about 10 to 25 mm for decreasing the rotation resistance with the bearing. If the journal diameter is too large, the rotation resistance increases, making the rotation of a free roller difficult. If the journal diameter is too small, the roller has an insufficient strength. More preferably, the journal diameter is about 10 to 15 mm. In this embodiment, a journal diameter of 15 mm is selected. The journal

diameter is not limited to this range. Normally, a slide caliper is used to measure the journal diameter.

[0054] It is preferred that the angle of the contact surface of the film carrier roller and the film (film holding angle) be 90 to 160°. Specifically, as shown in FIG. 7, the holding angle of the last two rollers (the film carrier rollers 27 and 28) is preferably within the range of 90 to 160° at least as viewed from the winding shaft. The reason therefor is as follows. If the holding angle is too small, the roller does not rotate, causing the film to meander or causing the film to have scratches. If the holding angle is too large, the film tension is decreased. As a result, the holding tension of the wound product cannot be controlled, and a trouble occurs that winding is too tight or the like.

[0055] It is preferred that the film contact surface of the film carrier rollers 27 and 28 be formed of a porous material or a slightly adhesive material. The reason for using a porous material in the above-mentioned film contact surface is as follow. By using a porous material, weaving of the end surface of a rolled film product (step-like irregularities) caused by lateral shift of the film due to the air which has entered between the film 10 and the film carrier rollers 27 and 28 can be effectively prevented. Examples of the porous material include foaming materials. Of them, rubber materials are preferable since they do not get scratches, they exhibit excellent durability or for other reasons. When an adhesive material is used in the above-mentioned film contact surface, it is preferable to use a slightly adhesive rubber material in order not to adversely affect the holding tension (winding tightness) of a wound product. Depending largely on the properties of a wound product, a rubber material having a friction coefficient of 0.7 to 0.8 and a rubber hardness of 40 to 80° is preferable.

<Nip Bar>

[0056] In the automatic film winding apparatus 2 of this embodiment, as a holding means which holds the film 10 which has stopped, a nip bar 26 is provided below the first film carrier roller 27.

This nip bar 26 is a metal bar of which the top surface is formed of a resin or rubber, and has almost the same length as that of the first film carrier roller 27. The nip bar 26 reciprocates up and down by a reciprocating driving means such as an air cylinder. The nip bar 26, when moved upwardly, presses the film 10 which has stopped to the first film carrier roller 27 and holds so that it does not move.

Due to the provision of the nip bar 26, the film 10 which has stopped is effectively prevented from shifting in the lateral direction, ensuring further suppression of a bad start. By the above-mentioned structure, the film 10 can be held reliably. In addition, due to the simplified structure, manufacturing cost can be reduced.

[0057] Next, the action and effect of the automatic film winding apparatus 2 having the above-mentioned configuration will be described with reference to the drawings.

FIG. 8 is a schematic cross sectional view of the essential parts of the automatic film winding apparatus according to one embodiment of the invention as viewed from the lateral direction for explaining each operation.

As shown in FIG. 8(a), in the automatic film winding apparatus 2, when a predetermined amount of the film 10 is wound around the winding core 12 of the first winding shaft 21, the first winding shaft 21 stops rotating (Step S1).

At this time, the first winding shaft 21 and the second winding shaft 22 are not rotating, the touch roller 23 is pressing, the film affixing roller 25, the cutter 24 provided with a guide and the nip bar 26 are waiting, and the winding core positioning means 29 is at the positioning position. The first winding shaft 21 is at the film winding position and the second winding shaft 22 is at the waiting position.

[0058] When winding the film 10, the touch roller 23 presses the film 10 to be wound around the winding core 12. As a result, the touch roller 23 functions as an air bleeding mechanism between the films 10 to be wound. If the first winding shaft 21 stops rotating, the touch roller 23 keeps on pressing.

During winding the film 10, the contact angle (film holding angle) of the carrier rollers 27 and 28 and the film 10 is preferably 90° to 160°. If the holding angle is smaller than 90°, the rotation of the carrier roller becomes insufficient, causing the film to meander. When the holding angle is larger than 160°, film tension becomes too strong, causing difficulty in the adjustment of the film tension on the winding shaft.

When winding the film 10, a pressure control mechanism (expanded packing 211) adjusts the pressure applied on the winding core 12, whereby a tension suitable for film winding can be ensured.

[0059] Next, as shown in FIG. 8(b), the film 10 which is hung on the first film carrier roller 27 is held by the nip bar 26. Subsequently, the touch roller 23 rotates upward, and the turret 20 rotates by 180°, and the film 10 is hung on the second winding shaft 22 (Step S2).

At this time, the first winding shaft 21 moves to the waiting position and the second winding shaft 22 moves to the winding position.

[0060] At this time, the first winding shaft 21 and the second winding shaft 22 are not rotating, the nip bar 26 is holding, and the touch roller 23, the film affixing roller 25, the cutter 24 provided with a guide and the winding core positioning means 29 are waiting.

Due to the holding of the film 10 by the nip bar 26, occurrence of a bad start can be prevented more reliably.

Before the turret 20 starts to rotate, an operator applies an adhesive to part of the surface of the winding core 12 of the second winding shaft 22, positions this winding core 12 on the second winding shaft 22 by means of the winding core positioning means 29, and the winding core positioning means 29 are rotated to the waiting position.

If the turret 20 rotates, the winding core 12 of the first winding shaft 21 is returned in the counterclockwise direction. However, due to the holding torque of the expanded packing 211, the film 10 is in the tensed state. That is, it keeps the tension suitable for film cutting.

[0061] Next, as shown in FIG. 8(c), the touch roller 23 rotates downward and presses the film 10 to the winding core 12 of the second winding shaft 22. Subsequently, the cutter 24 provided with a guide rotates downward, and cuts the film 10 linearly between the first winding shaft 21 and the second winding shaft 22 (Step S3).

At this time, the first winding shaft 21 and the second winding shaft 22 are not rotating, the nip bar 26 is holding, the touch roller 23 is pressing, the cutter 24 provided with a guide is cutting, and the film affixing roller 25 and the winding core positioning means 29 are waiting.

In this embodiment, when cutting the film 10, the first winding shaft 21 stops rotating. The configuration is, however, not limited thereto. Four example, when cutting the film 10, the first winding shaft 21 may be rotated at a speed of 15 m/min or less (a small rpm corresponding to the winding speed of 15 m/min or less). By doing this, the tension of the cut surface of the film can be ensured.

[0062] Then, as shown in FIG. 8(d), the cutter 24 provided with a guide rotates upward, the film affixing roller 25 rotates downward, and presses the film 10 which has been cut to the winding core 12 of the second winding shaft 22 at a position on the downstream side of the touch roller 23(Step S4).

At this time, the first winding shaft 21 and the second winding shaft 22 are not rotating, the nip bar 26 is holding, the touch roller 23 is pressing, the film affixing roller 25 is pressing, and the cutter 24 provided with a guide and the winding core positioning means 29 are waiting.

[0063] Then, as shown in FIG. 8 (e), the film affixing roller 25 further rotates downward, and moves to the front end of the film 10 which has been cut while winding the film 10 around the winding core 12 with the film 10 being pressed to the winding core 12 (Step S5).

At this time, the first winding shaft 21 and the second winding shaft 22 are not rotating, the nip bar 26 is holding, the touch roller 23 is pressing, the film affixing roller 25 is pressing, and the cutter 24 provided with a guide and the winding core positioning means 29 are waiting.

The front end of the film 10 which has been cut is away from the film cutting position within a range of several millimeters below the decimal point to several tens of millimeters.

[0064] In this embodiment, as shown in FIG. 9, a roller 251 of the film affixing roller 25, which is indicated by a dotted line, abuts the film 10 from the obliquely above as view from the front side, and presses the film 10 to the winding core 12 (Step S4). In the above step S5, the roller 251 moves by about 100° with the film 10 being pressed to the winding core 12, and maintains its pressed state (this roller 251 is indicated by a solid line). As a result, the film 10 between the roller 231 and the roller 251 indicated by a dotted line adheres to the winding core 12. In particular, the film 10 between the roller 251 indicated by a dotted line and the roller 251 indicated by a solid line is forcibly adhered to the winding core 12 by the roller 251. That is, slackening of the film 10 between the pressing position by the roller 231 of the touch roller 23 and the front end of the film 10 which has been cut can be effectively prevented, whereby the film 10 can be wound while maintaining the state in which the film 10 is adhered to a predetermined position of the winding core. As a result, troubles such as a bad start, wrinkles of the film or folded film corners which occur during film winding can be reasonably prevented.

The distance (angle) for which the roller 251 moves with the film 10 being pressed to the winding core 12 is not limited to 100° as mentioned above, and can be within the range of about 60° to 130° according to the kind (adhesive strength) of the film or the like.

[0065] It is preferred that, as shown in FIG. 9, the angle at which the film 10 is wound around the winding core 12 (winding angle) be within the range of 30° to 90°, more preferably, a larger angle within the above-mentioned range. By this angle, the front end of the film 10 which has been cut can be inserted between the film 10 to be supplied and the winding core 12 with a shorter distance. As a result, winding quality (in particular, prevention of folded film corners) can be improved.

The winding angle refers to an angle formed by the position right above the winding core 12 and the position at which the film 10 to be supplied is brought into contact with the winding core 12.

[0066] Next, as shown in FIG. 8 (f), while keeping the state where the film affixing roller 25 is pressing the front end of the film 10 which is being pressed to the winding core 12 by the film affixing roller 25, the second winding shaft 22, which is a friction shaft, rotates in the winding direction at a predetermined torque which is enough to remove slackening (Step S6).

At this time, the first winding shaft 21 is not rotating, the second winding shaft 22 is rotating at a low speed, the nip bar 26 is holding, the touch roller 23 is pressing, the film affixing roller 25 is pressing, and the cutter 24 with a guide and the winding core positioning means 29 are waiting.

In addition, slackening can be completely removed by a low-speed operation at the above-mentioned predetermined torque which is sufficient to remove the slackening. That is, as shown in FIG. 10(a), for example, a slight degree of slackening may remain between the roller 231 of the touch roller 23 and the roller 251 of the film affixing roller 25. In this case, such slackening can be completely removed by allowing the winding core 12 to rotate by a small angle (from the X position to the X_1 position) according to the amount of slackening without allowing the film 10 on the upstream side of the touch roller 23 to advance. As a result, troubles such as a bad start, wrinkles of the film or folded film corners which occur during film winding can be reasonably avoided, thus realizing a reliable winding technology.

The low-speed rotation of the second winding shaft 22 in the step S6 is normally performed at an rpm corresponding to a speed which is 50% or less of the film winding speed. Specifically, when the film winding speed is 50 m/min, the second winding shaft 22 rotates at a small rpm which corresponds to the winding speed of 25 m/min or less.

[0067] Next, as shown in FIG. 8 (g), the nip bar 26 moves downward, and the first film carrier roller 27 stops holding the film 10. Subsequently, the second winding shaft 22 rotates at a low speed in the winding direction at a predetermined winding torque, and the film 10 is wound around the winding core 12 of the second winding shaft 22. Furthermore, when the front end of the film 10 which has been cut approaches the position where the films 10 overlap one on another, the touch roller 23 and the film affixing roller 25 rotate upward, and stop pressing the film 10 (Step S7).

At this time, the first winding shaft 21 is not rotating, the second winding shaft 22 is rotating at a low speed, and the nib bar 26, the touch roller 23, the film affixing roller 25, the cutter 24 with a guide and the winding core positioning means 29 are waiting. Normally, the second winding shaft 22 rotates half to several times at the above-mentioned low speed, whereby the films 10 overlap one on another accurately.

The low-speed rotation of the second winding shaft 22 in the step S7 is normally performed at an rpm corresponding to a speed which is 50% or less of the film winding speed. Specifically, when the film winding speed is 50 m/min, the second winding shaft 22 rotates at a low speed with a small rpm which corresponds to the winding speed of 25 m/min or less.

[0068] Next, as shown in FIG. 8(h), when the front end of the film 10 which has been cut passes the position at which the films 10 overlap one on another, the touch roller 23 rotates downward again, and presses the film 10 to the winding core 12 of the second winding shaft 22. Subsequently, the second winding shaft 22 rotates in the winding direction at a predetermined winding up torque (Step S8).

At this time, the first winding shaft 21 is not rotating, the second winding shaft 22 is rotating at a predetermined winding speed, the touch roller 23 is pressing, and the nip bar 26, the film affixing roller 25, the cutter 24 provided with a guide and the winding core positioning means 29 are waiting.

[0069] Next, although not shown, an operator removes from the first winding shaft 21 the winding core 12 around which the film 10 has been wound in advance from the first winding shaft 21, and then inserts a new winding core 12 into the first winding shaft 21 (Step S9).

[0070] As mentioned hereinabove, according to the automatic film winding apparatus 2 of this embodiment, slackening of the film 10 between the pressing position by the touch roller 23 and the front end of the film 10 which has been cut is effectively suppressed, and therefore, the film 10 can be wound with the film 10 being closely adhered to the predetermined position of the winding core 12. As a result, troubles such as a bad start, wrinkles of the film or folded film corners which occur during film winding can be prevented, whereby winding quality can be significantly improved.

By allowing the winding shafts 21 and 22 to rotate at a low speed with a torque sufficient to remove slackening, a slight degree of slackening can be removed to improve winding quality.

The invention is effective also as the invention of the slit winding system 1. That is, due to the provision of the automatic film winding apparatus 2, both quality and productivity can be improved.

[0071] Next, one embodiment of the method for producing a rolled film will be explained.

First, as shown in FIG. 11, the first winding shaft 21 stops rotating when a predetermined amount of the film 10 is wound around the winding core 12 of the first winding shaft 21 (Step S1).

Next, the nip bar 26 allows the film 10 which has stopped to be held by the first film carrier roller 27, the touch roller 23 stops pressing the film 10, the turret 20 rotates by 180° to allow the film 10 to be hung on the winding core 12 of the second winding shaft 22 (Step S2).

Subsequently, the touch roller 23 presses the film 10 to the winding core 12 of the second winding shaft 22, and the cutter 24 provided with a guide cuts the film 10 (Step S3).

[0072] Next, at a position on the downstream side of the touch roller 23, the film affixing roller 25 presses the film 10 which has been cut to the winding core 12 of the second winding shaft 22 (Step S4).

Subsequently, the film affixing roller 25 moves to the front end of the film 10 which has been cut while winding the film 10 with the film 10 being pressed (Step S5).

Then, the second winding shaft 22, which is a friction shaft, rotates at a low speed in the winding direction at a predetermined torque which is sufficient to remove slackening (Step S6).

[0073] Then, the nip bar 26 stops holding the film 10, and the second winding shaft 22 rotates at a low speed in the winding direction at a predetermined winding torque. When the film 10 is wound around the winding core 12 of the second winding shaft 22, and the front end of the film 10 which has been cut approaches to the position where the films 10 overlap one on another, the touch roller 23 and the film affixing roller 25 stop pressing (Step S7).

Subsequently, when the front end of the film 10 which has been cut passes the position where the films 10 overlap one on another, the touch roller 23 presses the film 10 to the winding core 12 of the second winding shaft 22, and the second winding shaft 22 rotates in the winding direction at a predetermined winding up torque (Step S8).

Then, the winding core 12 around which the film 10 has been wound in advance is removed from the first winding shaft 21, and a new winding core 12 is inserted into the first winding shaft 21 (Step S9).

[0074] As mentioned hereinabove, the invention is effective as a method for producing a rolled film, and can improve both quality and productivity.

[0075] In the slit winding system 1, the automatic film winding apparatus 2 and the method for producing a rolled film of the above-mentioned embodiment, the automatic film winding apparatus 2 has a configuration in which the automatic winding apparatus 2 is provided with the turret 20, the cutter 24 provided with a guide, the nip bar 26, the winding core positioning means 29 or the like. The invention is, however, not limited thereto.

For example, as shown in FIG. 9, the automatic film winding apparatus of the invention may have a simple configuration in which it is provided with only one winding shaft 22, the touch roller 23 (the roller 231) and the film affixing roller 25 (the roller 251). That is, this automatic film winding apparatus is not necessarily provided with the turret 20, the cutter 24 provided with a guide, the nip bar 26 and the winding core positioning means 29 or the like.

[0076] In this case, an operator cuts the film 10 which has been wound around the winding core 12, and removes the rolled film 10 and the winding core 12, sets a new winding core 12 and hangs the film 10 on a new winding core 12. By doing this, in this automatic film winding apparatus, the touch roller 23 and the film affixing roller 25 effectively suppress slackening of the film 10 between the pressing position by the touch roller 23 and the front end of the film 10. Specifically, in this automatic film winding apparatus, since it is possible to wind the film 10 with the film 10 being closely adhered to a predetermined position of the winding core 12, winding quality is significantly improved.

The automatic film winding apparatus with the above-mentioned simple configuration may optionally have various functions or structures (for example, an automatic cutter, a plurality of winding mechanisms, rotatable touch rollers or film affixing rollers).

In addition, this automatic film winding apparatus with this simple configuration is effective when used in producing a rolled film. By using this automatic film winding apparatus in producing a rolled film, winding quality is significantly improved. Further, this method for producing a rolled film may have a step of allowing the shaft to rotate in the winding direction with a torque which is sufficient to remove slackening, or other steps.

[0077] The automatic film winding apparatus, the slit winding system and the method for producing a rolled film are explained hereinabove with reference to preferred embodiments. However, the invention is not limited to the above-mentioned embodiments, and it is needless to say that various modifications are possible within the scope of the invention.

For example, an adhesive such as glue is used as the retaining means which retains the film 10 which has been wound around the winding core 12 by the film affixing roller 25 on the surface of the winding core 12. The retaining means is, however, not limited to an adhesive. For example, depending on the properties of the film 10, adsorption by static electricity, air spraying, adhesion by a double coated adhesive tape or the like may be used. By using these methods, a trouble that the front end of the film 10 peels off from the surface of the winding core 12 before the films 10 overlap one on another can be avoided reliably.

In addition, as mentioned hereinabove, by using the apparatus of the invention, to say nothing of the semi-automatic winding, fully automatic winding can be realized easily.

INDUSTRIAL APPLICABILITY

[0078] Although the invention relates to the automatic film winding apparatus for winding a film, the slit winding system and a method for producing a rolled film, the materials or structures of the film are not particularly limited. Examples of the materials of the film include a resin, a metal, a cloth, paper or the like, and a mixture thereof. As for the structure of the film, a laminate structure obtained by stacking layers of different materials or the like may be used.

Claims

1. An automatic film winding apparatus comprising:

   a winding shaft for winding a film around a winding core;
   a touch roller for pressing the film which has been hung on the winding core to the winding core; and
   a film affixing roller which presses the film to the winding core at a position on the downstream side of the touch roller, and moves to the front end of the film while winding the film with the film being pressed to the winding core.

2. The automatic film winding apparatus according to claim 1, which has a cutter for cutting the film.

3. An automatic film winding apparatus comprising two or more winding shafts for winding a film around a winding core, a turret which moves the two or more winding shafts to a film winding position and a waiting position, and a cutter for cutting the film, which further comprises:

   a touch roller which presses the film to the winding core of a second winding shaft of the two or more winding shafts when a predetermined amount of the film is wound by a first winding shaft at the film winding position of the two or more winding shafts, the turret is rotated by a predetermined angle and, the film is hung on the winding core of the second winding shaft of the

two or more winding shafts which has moved to the film winding position;
the cutter which cuts, between the first winding shaft and the second winding shaft, the film which has been pressed by the touch roller; and
a film affixing roller which presses the film which has been cut to the winding core of the second winding shaft at a position on the downstream side of the touch roller and moves to the front end of the film which has been cut while winding the film with the film being pressed.

4. The automatic film winding apparatus according to claim 3, which is capable of removing the rolled film from the first winding shaft which is at the waiting position and setting the winding core to the first winding shaft while winding a film by the second winding shaft.

5. The automatic film winding apparatus according to any one of claims 1 to 4, further comprising two or more winding mechanisms which have the touch roller and the film affixing roller.

6. The automatic film winding apparatus according to any one of claims 2 to 5, wherein the touch roller has arms for a touch roller which rotatably support the touch roller, the cutter has a pair of arms for a cutter which rotatably supports the cutter, the film affixing roller has a pair of arms for a film affixing roller which rotatably supports the film affixing roller, the pair of arms for a film affixing roller are located between the pair of arms for the cutter, and the two or more arms for a touch roller are located between the pair of arms for a film affixing roller.

7. The automatic film winding apparatus according to any one of claims 1 to 6, further comprising an air bleeding mechanism.

8. The automatic film winding apparatus according to claim 7, wherein the air bleeding mechanism is a touch roller.

9. The automatic film winding apparatus according to any one of claims 1 to 8, further comprising a film carrier roller for supplying the film to the winding shaft.

10. The automatic film winding apparatus according to claim 9, further comprising a holding means which holds the film by pressing the film to the film carrier roller.

11. The automatic film winding apparatus according to claim 10, wherein the holding means is a nip bar for pressing the film to the film carrier roller.

12. The automatic film winding apparatus according to any one of claims 9 to 11, wherein the angle of the contact surface of the film carrier roller and the film (film holding angle) is 90 to 160°.

13. The automatic film winding apparatus according to any one of claims 9 to 12, wherein the film contact surface of the film carrier roller is composed of a porous material or a slightly adhesive material.

14. The automatic film winding apparatus according to any one of claims 1 to 13, further comprising a winding core positioning mechanism for positioning the winding core in the width direction of the film.

15. The automatic film winding apparatus according to claim 14, wherein the winding core positioning mechanism is provided with a bar material mounted such that it can move freely between the positioning position and the waiting position and a stopper mounted on the bar material such that it can move freely.

16. The automatic film winding apparatus according to any one of claims 1 to 15, further comprising a film tension control system.

17. The automatic film winding apparatus according to claim 16, wherein, in the film tension control system, the winding shaft is a friction shaft and the winding shaft is rotated in the winding direction with such a torque that enables the winding core to slide against the film which has been pressed by the touch roller in the state where the film affixing roller is pressing the front end of the film.

18. The automatic film winding apparatus according to any one of claims 2 to 17, wherein the cutter is provided with a guide member and a cutting blade which moves along the guide member, and the film which is imparted with tension by the abutment of the guide member is cut by the cutting blade.

19. The automatic film winding apparatus according to any one of claims 1 to 18, further comprising a retaining mechanism which retains the film which has been wound around the winding core by the film affixing roller to the surface of the winding core.

20. The automatic film winding apparatus according to any one of claims 1 to 19, wherein the film affixing roller is provided with a rotating shaft which is rotatably provided, a pair of arms provided such that they oppose to the rotating shaft, a pair of urging arms which are respectively connected rotatably to the front end of each of the pair of arms and urged in the direction of the rotating shaft, and a roller which is pivotably installed on the front end of each of the pair of urging arms in a rotatable manner.

21. A slit winding system comprising:

a slitter which cuts a film into a predetermined width; and
the automatic film winding apparatus according to any one of claims 1 to 20 for winding the film which has been supplied from the slitter.

22. The slit winding system according to claim 21, wherein at least one of the slitter and the automatic winding apparatus is movably provided.

23. A method for producing a rolled film in which a film is wound around a winding shaft, comprising:

a step in which the film is hung on a winding core of the winding shaft;
a step in which a touch roller presses the film to the winding core of the winding shaft; and
a step in which a film affixing roller presses the film to the winding core at a position on the downstream side of the touch roller, and moves up to the front end of the film while winding the film with the film being pressed.

24. A method for producing a rolled film in which a film is wound around a plurality of winding shafts by turns, comprising:

a step in which a first winding shaft stops rotating when a predetermined amount of the film is wound around a winding core of a first winding shaft;
a step in which a turret holding the plurality of winding shafts rotates by a predetermined angle, allowing the film to be hung on the winding core of a second winding shaft, with the film being held by a carrier roller;
a step in which the touch roller presses the film to the winding core of the second winding shaft, and the cutter cuts the film between the first winding shaft and the second winding shaft;
a step in which the film affixing roller presses the film to the winding core of the second winding shaft at a position on the downstream side of the touch roller; and
a step in which the film affixing roller moves to the front end of the film with the film being pressed.

25. The method for producing a would film according to claim 24, further comprising a step in which the second winding shaft formed of a friction shaft rotates in the winding direction with a torque sufficient to remove slackening of the film which has been pressed by the touch roller in the state where the film affixing roller is pressing the front end of the films.

26. The method for producing a rolled film according to claim 24 or claim 25, comprising:

a step in which the touch roller and the film affixing roller stop pressing the film when the carrier roller stops holding the film, the second winding shafts rotates in the winding direction at a predetermined winding up torque, the film is wound around the winding core of the second winding shaft, and the front end of the film approaches an overlapping position, and
a step in which the touch roller presses the film to the winding core of the second winding shaft and the second winding shaft rotates in the winding direction at a predetermined torque when the front end of the film passes the overlapping position.

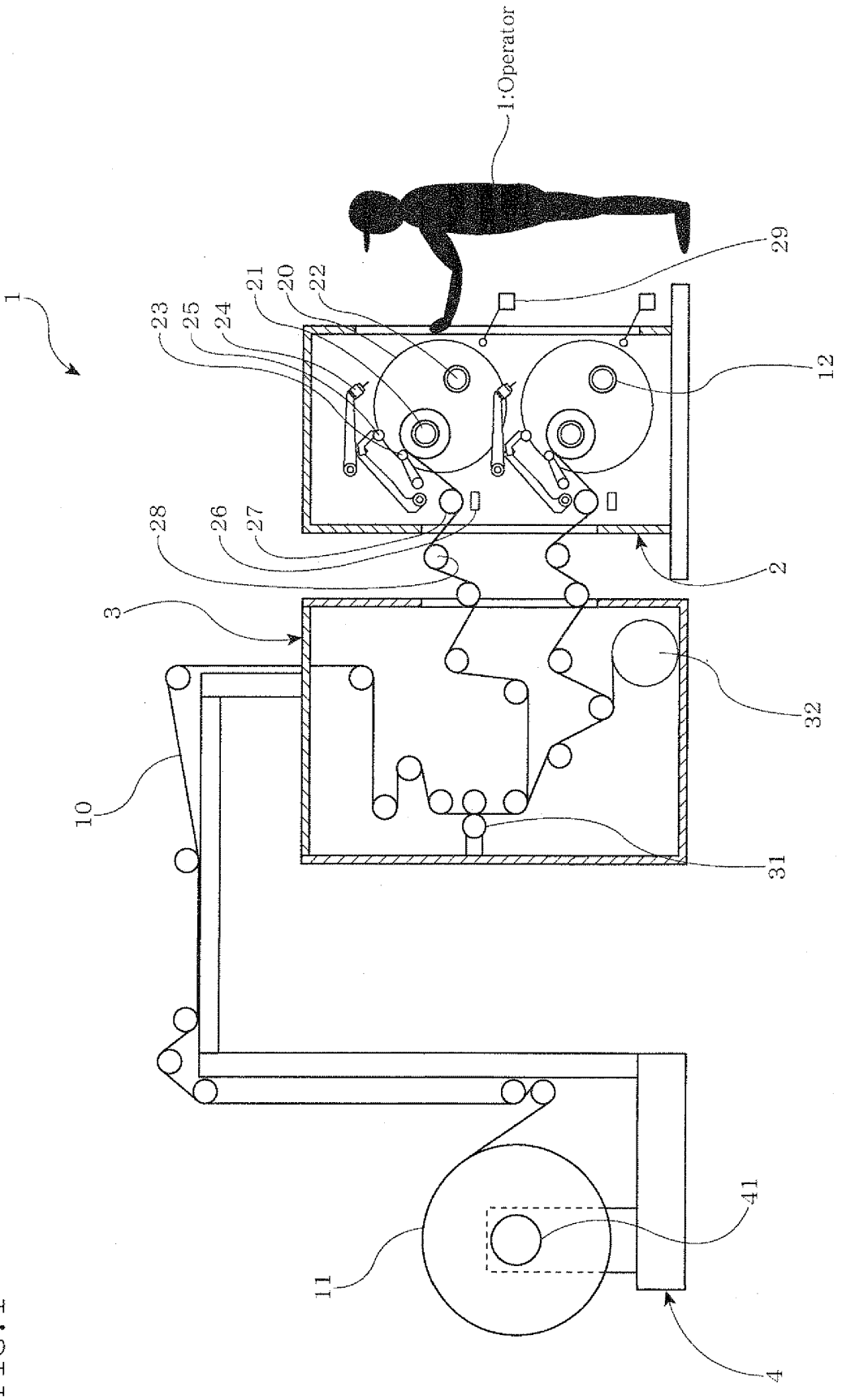


FIG.1

FIG.2

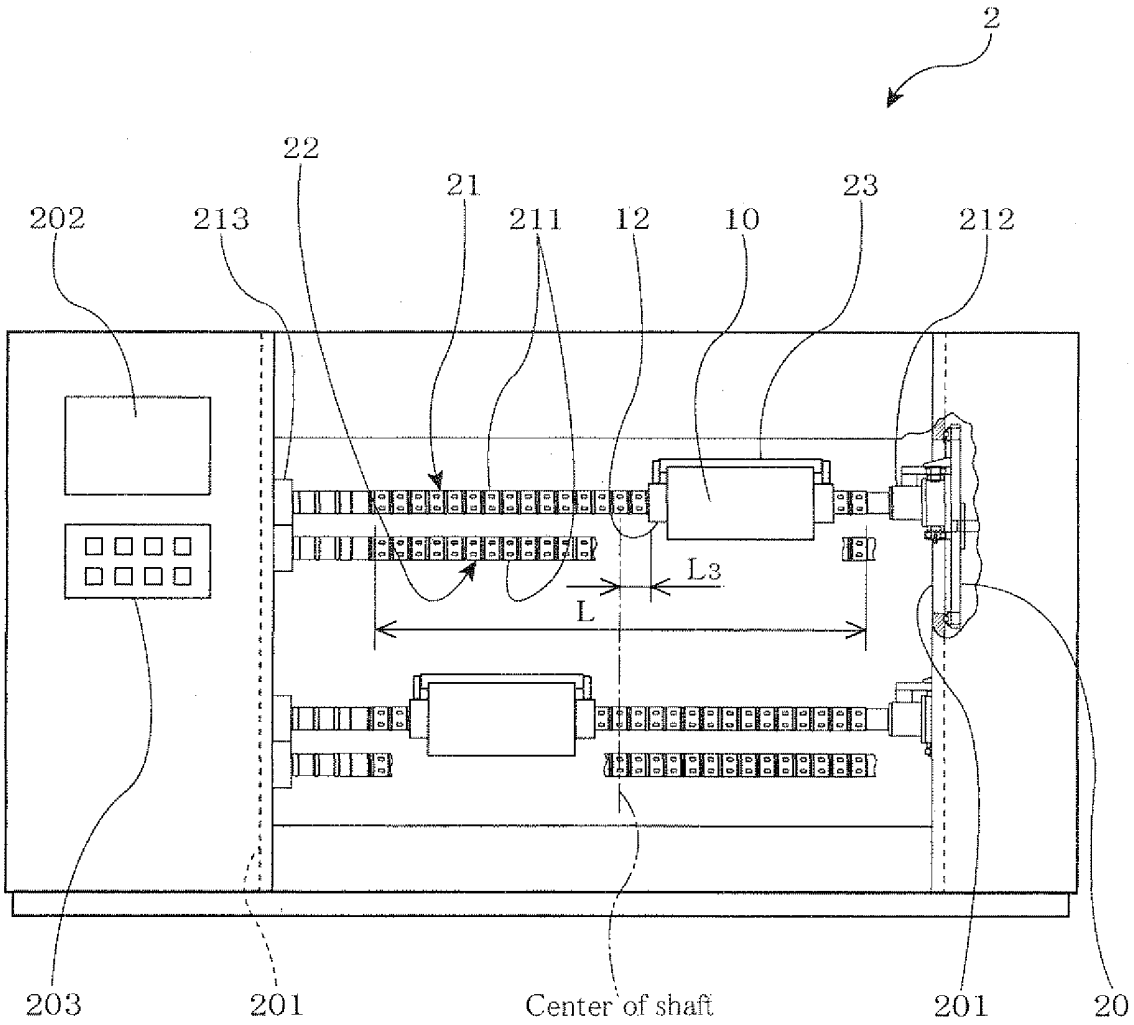
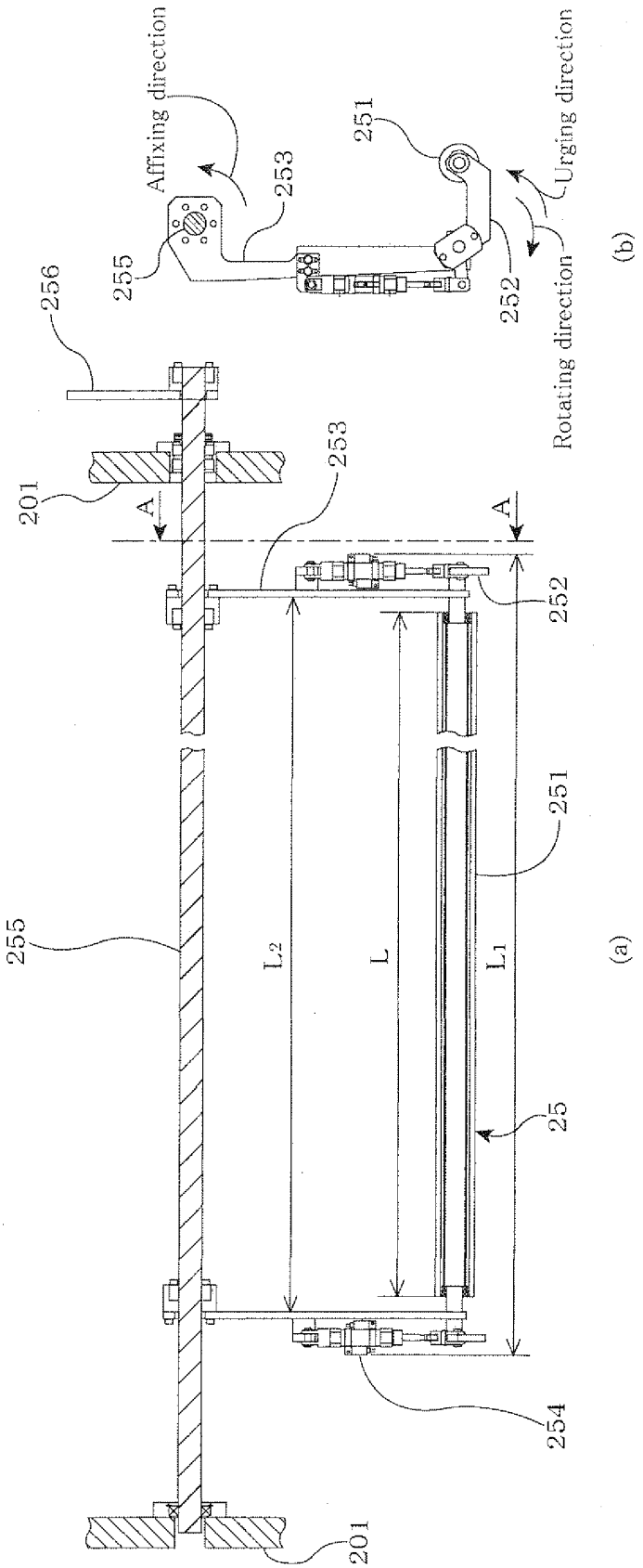

2
22
21
23
202
213
211
12
10
212
L3
L
203
201
Center of shaft
201
20

FIG. 3


Affixing direction
253
251
Urging direction
255
252
Rotating direction
(b)
256
253
201
A
A
252
251
255
L2
L
L1
(a)
25
254
201

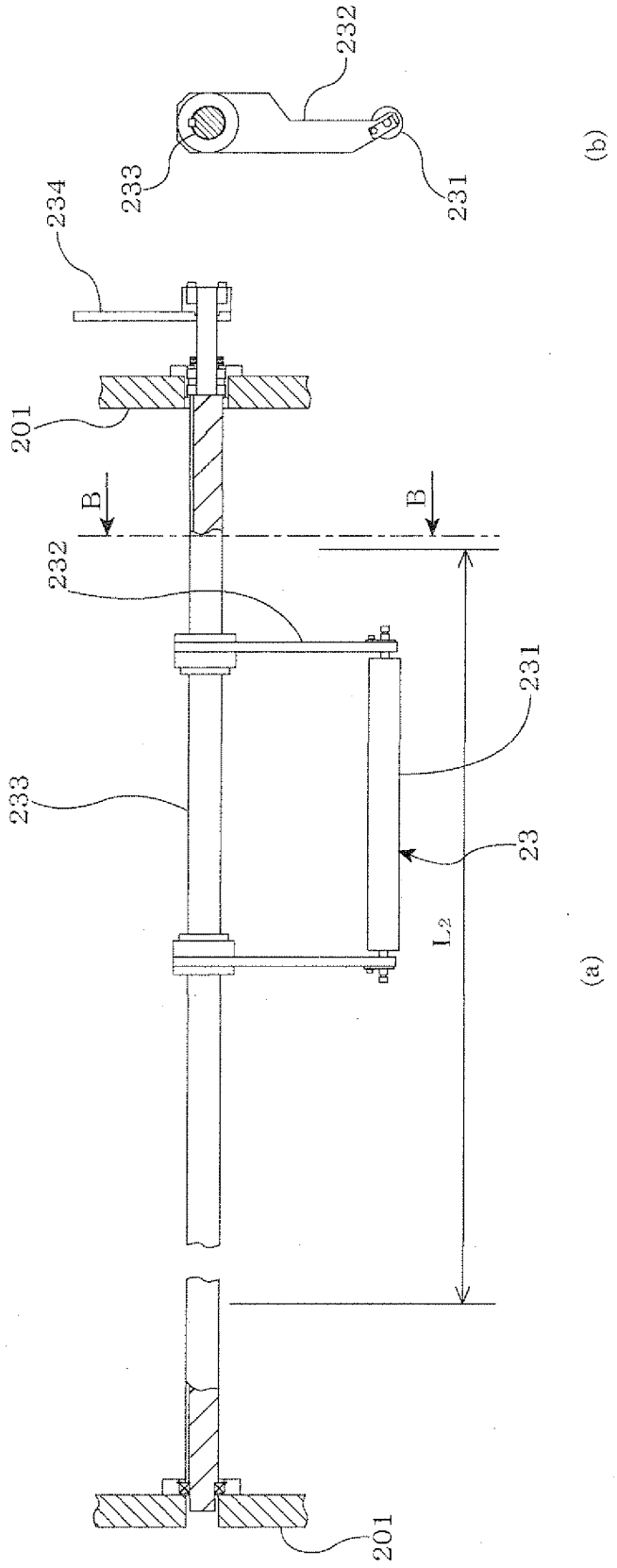


FIG. 4

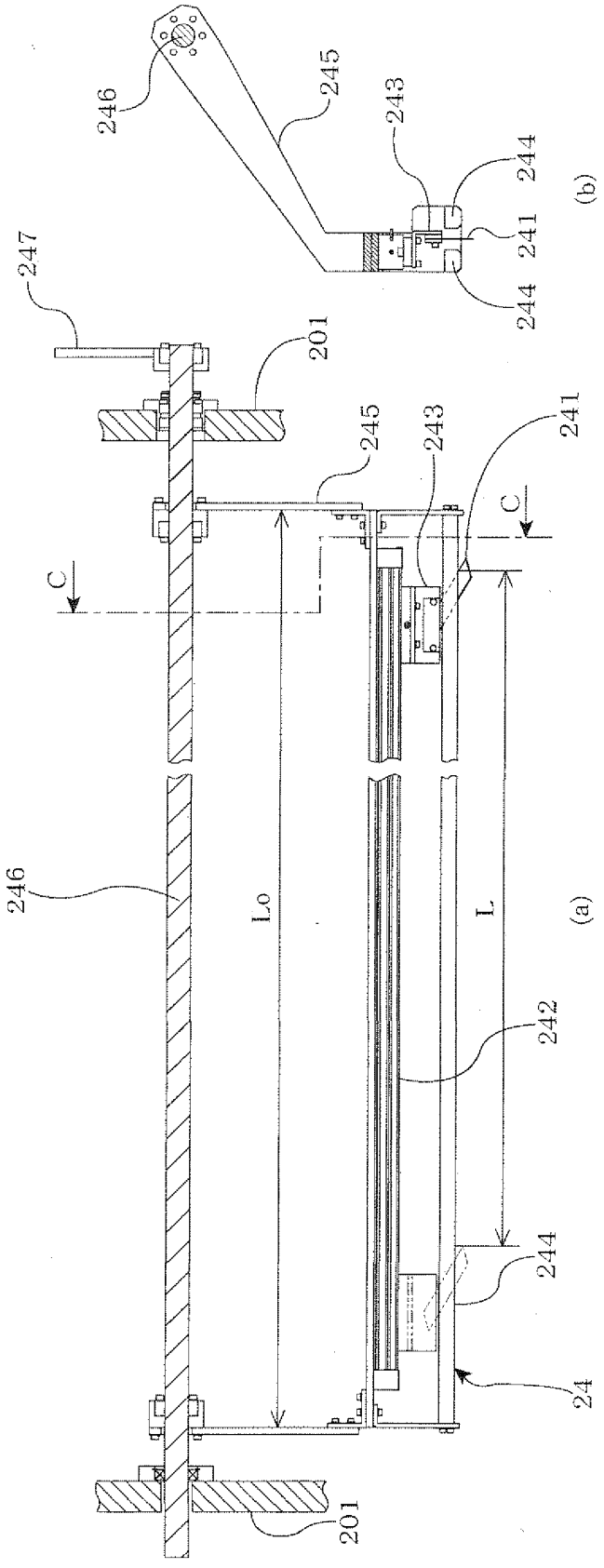

246
245
243
244
241
244
(b)
247
201
245
243
241
C
C
246
Lo
L
(a)
242
244
24
201

FIG. 5

FIG. 6

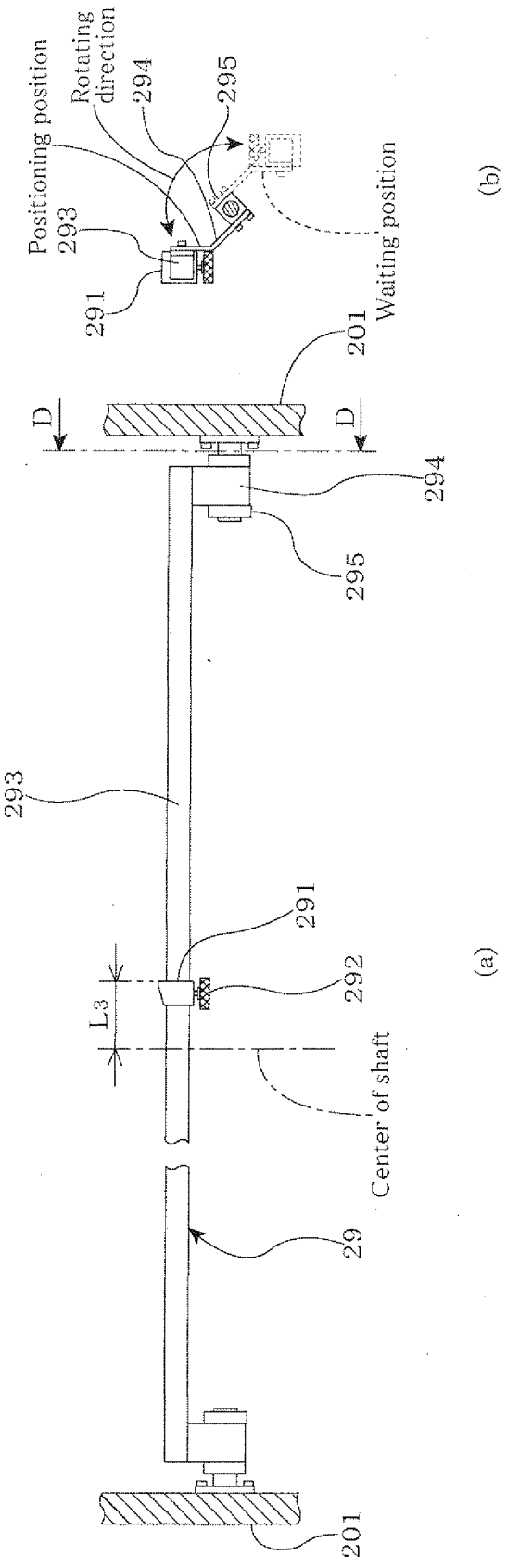

Positioning position
Rotating direction
294
295
293
291
Waiting position
(b)
201
D
D
294
295
293
291
292
L_3
Center of shaft
(a)
29
201

FIG.7

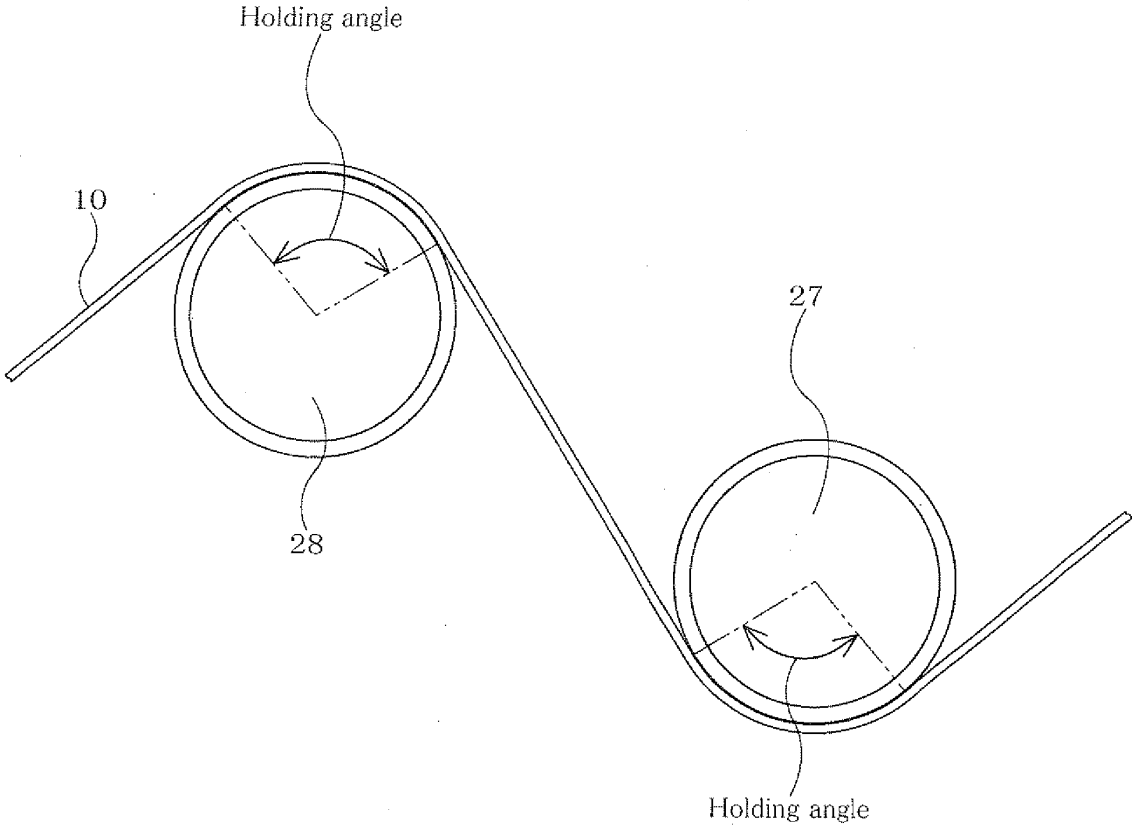


FIG. 8

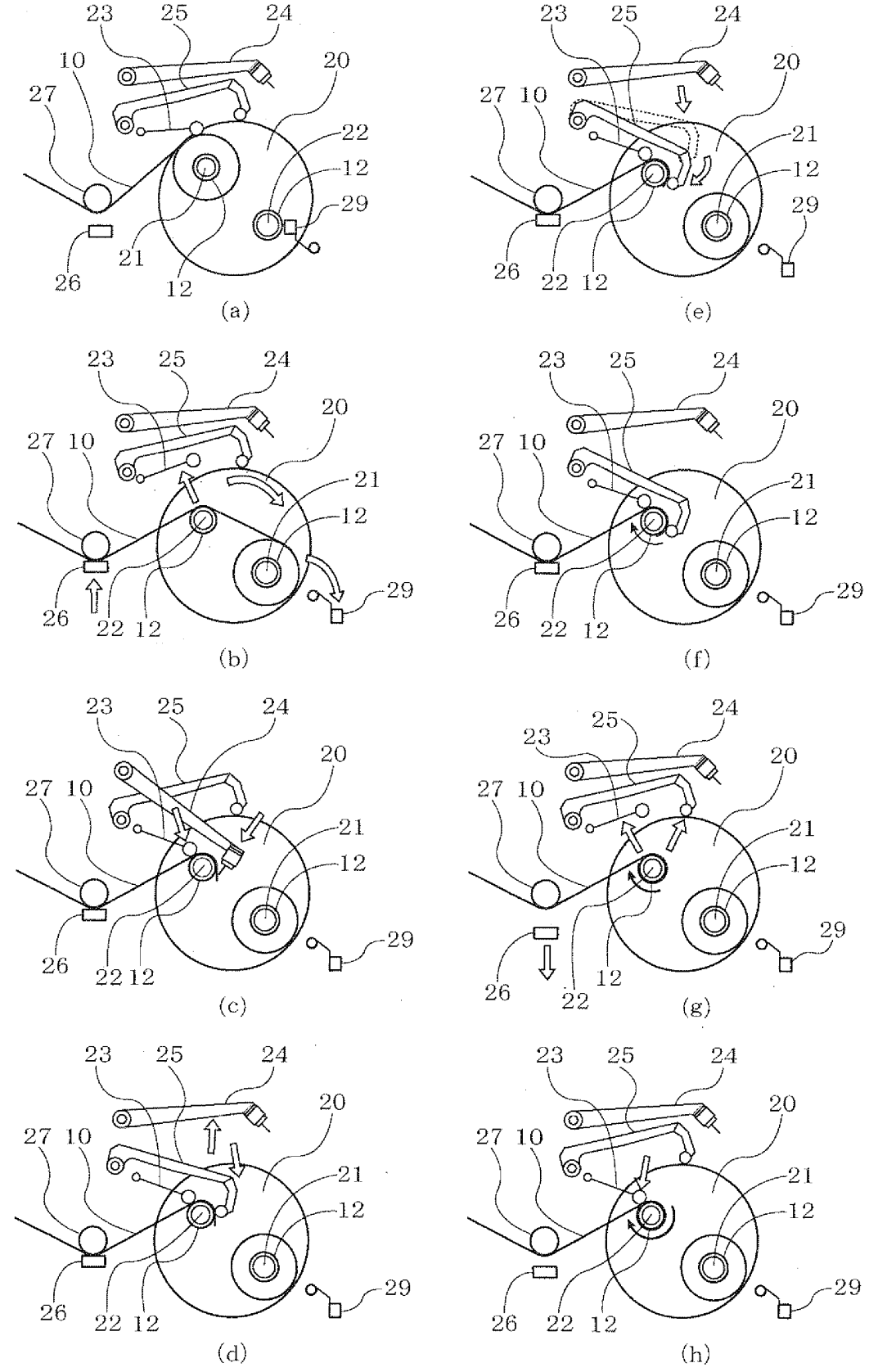


FIG.9

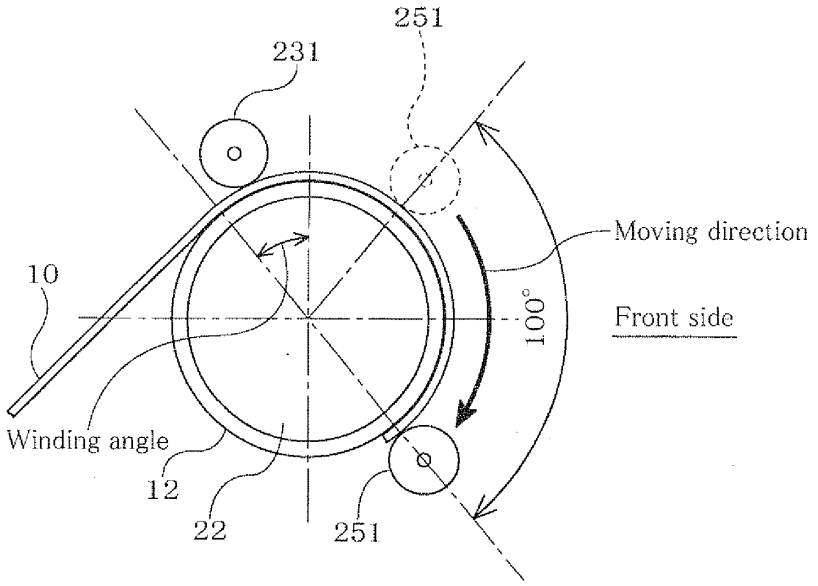

251
231
Moving direction
10
100°
Front side
Winding angle
12
22
251

FIG.10

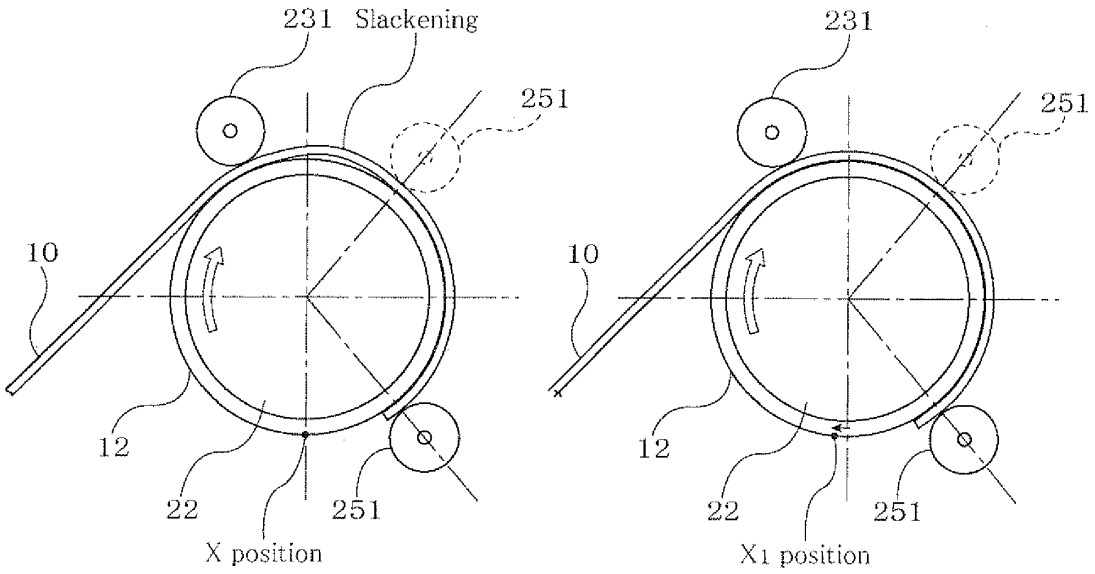
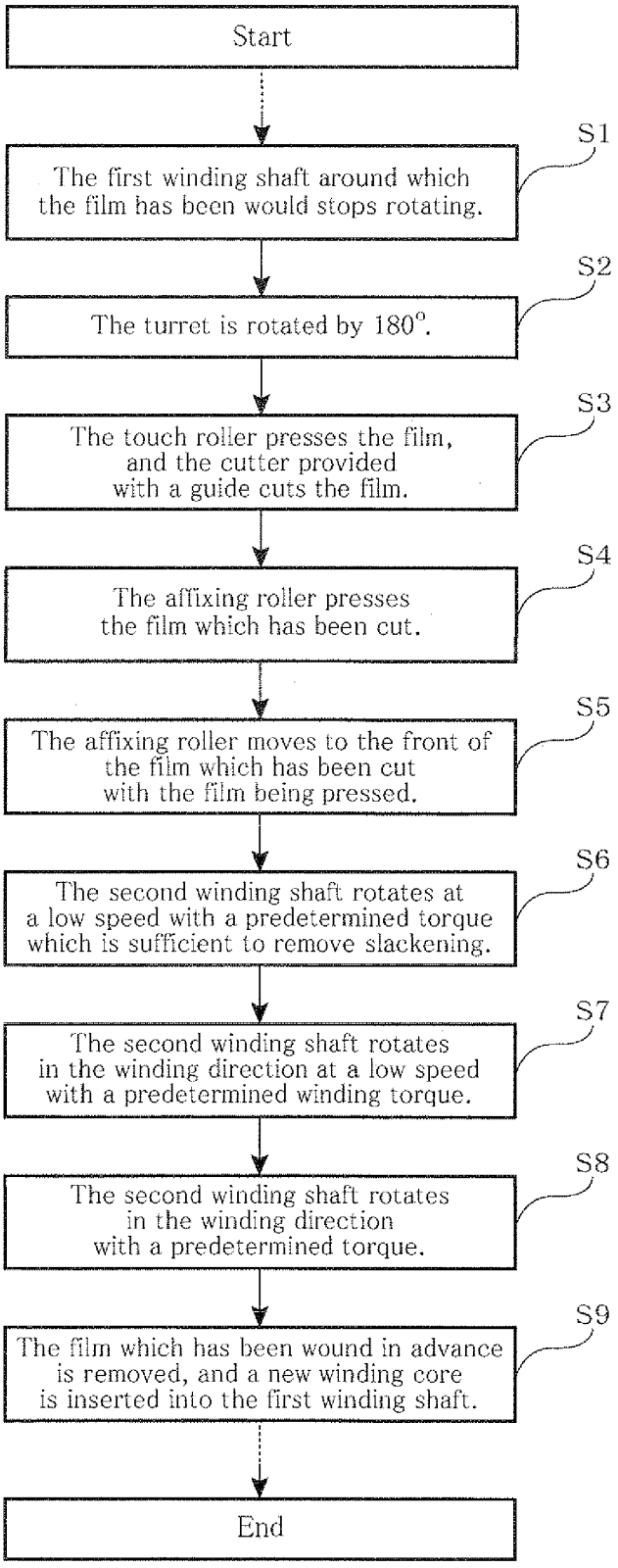

231
Slackening
251
10
12
22
251
X position
(a)
231
251
10
12
22
251
X1 position
(b)

FIG.11


Start
S1
The first winding shaft around which the film has been would stops rotating.
S2
The turret is rotated by 180°.
S3
The touch roller presses the film, and the cutter provided with a guide cuts the film.
S4
The affixing roller presses the film which has been cut.
S5
The affixing roller moves to the front of the film which has been cut with the film being pressed.
S6
The second winding shaft rotates at a low speed with a predetermined torque which is sufficient to remove slackening.
S7
The second winding shaft rotates in the winding direction at a low speed with a predetermined winding torque.
S8
The second winding shaft rotates in the winding direction with a predetermined torque.
S9
The film which has been wound in advance is removed, and a new winding core is inserted into the first winding shaft.
End

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/068770

A. CLASSIFICATION OF SUBJECT MATTER
B65H19/28(2006.01)i, *B65H19/22*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65H19/00-19/30

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007
Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 9-63565 A (Toshiba Battery Co., Ltd.), 07 March, 1997 (07.03.97), Page 2, column 2, line 48 to page 5, column 8, line 38; Fig. 1 (Family: none)	1-13,19-24 14-18,25,26
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 33081/1987(Laid-open No. 142353/1988) (Kataoka Machine Co., Ltd.), 20 September, 1988 (20.09.88), Description, page 3, lines 16 to 20; Figs. 3 to 4 (Family: none)	14-18

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 December, 2007 (14.12.07)	08 January, 2008 (08.01.08)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/068770

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2006-69794 A (Fuji Photo Film Co., Ltd.), 16 March, 2006 (16.03.06), Page 5, column 8, line 20 to page 30 (Family: none)	16-18,25,26
Y	JP 61-23060 A (Tsudakoma Corp.), 31 January, 1986 (31.01.86), Description, page 2, lower right column, lines 1 to 7; Fig. 11 & US 4606381 A & KR 9310319 B	18

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/068770

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The inventions of claims 1, 2, and 5-23 relate to an automatic film winding device having a winding shaft, a touch roller, and a film affixing roller.

The inventions of claims 3, 4, and 24-26 relate to an automatic film winding device having a turret, a winding shaft, a touch roller, and a film affixing roller.

The inventions of claims 1, 2, and 5-23 have no novelty or inventive step and have no special technical feature. Accordingly, the inventions of claims 1, 2, and 5-23 and the inventions of claims 3, 4, (continued to extra sheet)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☒ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

the

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2007/068770

Continuation of Box No.III of continuation of first sheet(2)

and 24-26 are not so linked as to form a single general inventive concept.
As a result, they do not satisfy the requirement of PCT Rule 13.1.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP S62215452 A **[0003]**
- JP H09104550 A **[0003]**
- JP 2001097616 A **[0003]**