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(54) **Package quality inspection device**

Vorrichtung zur Qualitätsüberprüfung von Spulen

Dispositif pour l'inspection de la qualité de bobines

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EP-A- 0 650 915 **EP-A- 0 749 929**
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- **PATENT ABSTRACTS OF JAPAN vol. 017, no. 603 (M-1505), 5 November 1993 -& JP 05 178541 A (TOYOBO CO LTD), 20 July 1993**

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Description

[0001] The invention relates to a package quality inspection device according to the preamble of claim 1.

[0002] A device of this type is known from JP-A-5178541 disclosing a winder for winding a molten and spun synthetic filament yarn into a package. This device is intended to detect fluffs because a synthetic filament yarn having fluffs is considered to be defective. The optical axis of the inspection device is therefore close to the package surface.

[0003] EP-A-0650915 discloses a package quality inspection device projecting a light slit parallel with the axis of a package the surface of which reflects the light slit to a detector. Normally a winder has a metallic traverse drum for rotating a package by friction contact. In this case a yarn quality inspection device comprises a light emitting element and a light receiving element arranged close to the contact line between the package and the traverse drum which is produced by a package processing machine. This contact line remains unchanged even if the diameter of the package increases. Due to the fact that the emitted light of the inspection device may be dispersed by the metallic surface of the traverse drum an abnormality of the outermost layer of the package cannot be detected.

[0004] The problem underlying the invention is therefore to provide a package quality inspection device avoiding detection errors due to the dispersion of the emitted light by the metallic surface of the traverse drum.

[0005] This problem is solved by the features defined in the characterizing portion of claim 1. Embodiments thereof are defined in the subclaims.

[0006] The invention will now be described by the way of example and with reference to the accompanying drawing in which:

Fig. 1 is a perspective view of a prior art package quality inspection device,

Fig. 2 is a side-view of the device of fig. 1,

Fig. 3 to 4 are side-views of the device of fig. 2 for explaining the operation of the device,

Fig. 6 is a front-view of a package quality inspection device according to the invention,

Fig. 7 is a front-view of a package winder, and

Fig. 8 is a perspective view of another embodiment of the device according to the invention.

[0007] It is known to form a yarn package by an auto-winder as shown in Figure 7. A guide 3 for guiding the yarn Y from the yarn supply bobbin 2 arranged on the lower part, a tensor 4 that applies a suitable tension on that yarn Y, a slub catcher 5 that detects defects in the yarn Y, a yarn piecing part 6 that joins the yarn Y When there is a yarn breakage or when the yarn is cut by the slub catcher 5, and a traverse drum 8 for rotating by friction contact the package P supported in the cradle arm 7, are sequentially arranged on the winding unit 1 of this auto-winder. A groove 9 for traversing the yarn Y is formed in outer peripheral surface of the traverse drum 8 and an end missing prevention cover 10 is arranged in front of that.

[0008] Furthermore, when piecing is carried out, a package side yarn end grasping means 11 (a suction mouth) and a yarn supply bobbin side yarn end grasping means 12 (a suction pipe) for guiding respectively the yarn from the package and the yarn from the yarn supply bobbin to the yarn piecing device 6 by rotational movement are provided.

[0009] During the production process of a package P any defects in the yarn Y are removed by the slub catcher 5 of the winding unit 1 and while any imperfection appearing on the surface of the wound package P can be discovered, a defective place inside the package generated by an inappropriate winding during formation of the package can not be discovered unless the package is unwound for the next process.

[0010] Figures 1 and 2 show the application of a package quality inspection device on an auto-winder.

[0011] A plurality of units of auto-winders are arranged in series on a winding unit 1 as shown in Figure 7. Such a quality inspection device is provided on each winding unit with an inspection means for inspecting a package P on a winding tube B during the winding process and is arranged with a yarn detection sensor 22 that senses whether or not a yarn exists on the outer side of the regular outermost layer 21 of the cone shaped package P.

[0012] The winding process also includes the stage of winding the yarn Y during yarn piecing. The regular outermost layer 21 of the package P is the outermost layer of the yarn layer defined by a circle with the axis C of the package P as the center and having a radius from that center to the contact point 25 between the package P and drive drum 8. In the case of a cone shaped package P, as the axis C of the package P is slanted along the axial direction with respect to the tangent of the package P and drive drum 8, the radius of regular outermost layer 21 of the package P naturally differs in the axial direction of the package P.

[0013] The yarn detection sensor 22 comprises a light emitting element 23 that emits laser light or the like for detection and a light receiving element 24 arranged opposite the light emitting element 23 and is arranged such that the detection light L from the light emitting element 23 passes close to the line of contact 25 (tangent) of the package P and drive drum (traverse drum) 8 for rotating the package P by friction contact. More specifically, the light detection sensor 22 is arranged such that the detection light L passes close to the drive drum 8 and regular outermost layer 21 of the package P but does not

lie on the periphery of the outermost layer 21 and drive drum 8. The reason that the yarn detection sensor 22 is arranged so that the detection light L passes close to the contact point 25 is because the position of the detection light L with respect to the outermost layer 21 does not change even if the winding diameter of the package P increases.

[0014] Furthermore, the yarn detection sensor 22 is arranged such that the detection light L passes along the front side of the winding unit F where the yarn Y is introduced onto the package P. In this way, package P errors (scramble, waste yarn, lifted yarn) become easier to be detected and the detection of double yarn end finding and end missing is possible as described later.

[0015] The package P is supported on the cradle arm 7 such that the contact line 25 retracts slightly with increases in the winding diameter but naturally, it is preferable to support the package P by the cradle arm 7 such that the contact line 25 does not change even if the winding diameter changes.

[0016] The objective of the inspection means is the inspection of the outer most layer 21 of the package P and as a result, it is important for the detection light L to pass close to the outermost layer 21 of the package P. The detection light L of the light emitting element 23 is parallel with the contact line 25 and is arranged so as to be in the on-state when this detection light L is cut off by an abnormality such as yarn outside of outermost layer 21 or the like.

[0017] Normally the yarn Y is wound on the surface of the package P while inserted in and being traversed by the traverse groove 9 of the drive drum 8. Due to this, there is no detection of the yarn Y by the yarn detection sensor 22 even if the detection light L passes close to the peripheral surface of the drive drum 8.

[0018] The light emitting element 23 is mounted on the upper surface of the main body frame 35 of the winding unit 1 via a bracket 26 and the light receiving element 24 is mounted via a bracket 28 on a cover 27 arranged over the front side F of the drive drum 8. The cover 27 comprises a plate having an arc-shaped cross section arranged close to the peripheral surface of the drive drum 8 and prevents end missing. The end of the side of the cover 27 furthest from the main body frame 35 is bent such that it follows the outer periphery of the axial end surface of the drive drum 8 and the bracket 28 is mounted on this bent part 29.

[0019] The cradle arm 30 that supports the package P has a center of rotation on the rear side R of the winding unit 1 and as the position of the contact point 25 hardly changes even if the winding diameter increases and there is no large movement of the positioning of the package surface near the contact line 25, and the yarn detection sensor 22 is always able to detect whether there are abnormalities or not under the same conditions even if its position is fixed. If the yarn detection sensor 22 is too close to the package P surface, there is the possibility of detecting fluffs of the outermost layer 21 thus it should be separated from the surface by a predetermined distance.

[0020] Also, the yarn detection sensor 22 is connected to the slab catcher 5 (Figure 7). If an abnormality is detected, the yarn Y may be immediately cut by a cutter attached to the slub catcher 5 or a cutter arranged elsewhere whereby the package P is separated from the drive drum 8 by the raising of the cradle arm 30 and the stoppage of the rotation of the package P by the application of a brake. Simultaneous with this, an alarm lamp 31 of the winding unit 1 is activated and the operator called in order to restore the operation.

[0021] Accordingly, the inspection of the package P during the entire winding process can be achieved by the operation of the yarn detection sensor 22 from the time when winding starts including the yarn piecing time and a stoppage of the winding can be performed immediately if disruptions of the package surface or the like are discovered. When, as shown in Figure 3 for example, a phenomenon as scramble whereby a circular yarn bundle 32 as shown by the arrow b shifts from the large diameter side of the cone shaped package P to the small diameter side due to there being a low friction resistance of the yarn Y or the like occurs and which easily occurs in the case of synthetic yarn, the detection light L of the light emitting element 23 is interrupted by the yarn bundle 32 and this can be immediately sensed. Furthermore, "tension breakage" where a yarn cut due to tension changes or the like winds once again onto the surface of the package P, or "lifted yarn" where the yarn is lifted from the outermost layer 21 of the package P due to contact pressure or tension can be similarly instantaneously detected.

[0022] Furthermore, as the yarn detection sensor 22 is arranged on the side F where yarn is guided onto the package P (the front side of the winding unit 1), abnormalities on the package P become easier to be detected due to the following reason.

[0023] By arranging the yarn detection sensor 22 on the rear side of the winding unit 1, immediately after the outermost layer 21 of the package P has been pressured by the drive drum 8, yarn bundle of scramble or lifted yarn or waste yarn generated by tension breakage or the like becomes pushed into the outermost layer 21 of the package P and thus package P abnormalities are difficult to be detected

[0024] However, by arranging the yarn detection sensor 22 on the front side F, yarn bundle of scramble or the like project from the outermost layer 21 of the package P by centrifugal force due to the high speed rotation of the package P and thus abnormalities become easier to be detected by the yarn detection sensor 22.

[0025] Furthermore, by arranging the sensor 22 on the front side F, detection of defective winding due to double end finding during yarn piecing is possible. Double yarn end finding is when the yarn end gripping means (suction mouth 11) pulls two yarns (the correct yarn Y and a yarn part 33 already wound on the package

P) from the package P during yarn piecing as shown in Figure 4A.

[0026] If these two yarns are supplied in this form to the yarn piecing device 6, the yarn piecing device 6 determines a yarn end finding error to have occurred and yarn piecing (the restart of winding) is not carried out.

[0027] However, when only one yarn is supplied to the yarn piecing device 6 even if double yarn end finding has occurred, the yarn piecing device 6 executes normal yarn piecing operations and when winding is restarted, the other pulled yarn 33 is wound onto the package P and causes a defective product. The yarn part 33 wound at this time is quickly detected by the yarn detection sensor 22 as it is facing from the front side F of the winding unit 1 towards the package P surface.

[0028] Furthermore, if for some reason, end missing occurs and as shown in Figure 5A, the suction mouth 11 finds the yarn 34 which has end missed together with the correct yarn Y during yarn piecing, similar to double yarn end finding, the yarn detection sensor 22 is able to detect this end missed yarn 34.

[0029] Yet further, when winding restarts, yarn waste is wound with the running of the yarn Y but as the yarn detection sensor 22 immediately detects this yarn waste, the inclusion of yarn waste in the package P can be prevented.

[0030] Whenever yarn piecing occurs, the yarn detection sensor 22 is operated only when winding restarts (immediately after yarn piecing). By the detection not occurring when the suction mouth 11 performs the yarn picking operation, an erroneous operation where the yarn Y

[0031] Apart from a laser sensor which uses laser light, a light sensor which filters light through a slit or the like may be used as the yarn detection sensor 22.

[0032] Figure 6 shows an embodiment of the present invention. This embodiment of the package quality inspection device differs when compared to the previously described quality inspection device in the positioning of a light emitting element 124 and a light receiving element 123 wherein the detection light L of a yarn detection sensor 122 passes at an angle from a position close to a drive drum 108 to position far from it. The light emitting element 124 and light receiving element 123 are mounted on a bracket 128, the light emitting element 124 is positioned on the small diameter side of a cone shaped package P, and the light emitting element 124 is positioned on the free end side of the drive drum 108 held by one side only.

[0033] The objective of the inspection means is the inspection of the surface (outer most layer) 121 of the package P and as a result, it is important for the detection light L to pass close to the outermost layer 121 of the package P. Due to this, it is preferable for the detection light L from the light emitting element 124 to be roughly parallel with a tangent 125 but as detection light reflected by the surface of the drive drum 108 is dispersed, the light emitting element 124 is positioned closer to the drive drum 108 than the light receiving element 123 so that the detection light L is slanted slightly with respect to the tangent 125 as shown in Figure 6. The yarn detection sensor 122 is arranged so as to be in a on-state when the detection light L is cut off by an abnormality such as yarn outside of outermost layer 21 or the like.

[0034] Even if the detection light L from the light emitting element 124 has directivity, the detection light L is dispersed and if it enters the light receiving element 123 by reflecting off the smooth surface of the drive drum 108 made of metal without being cut off by an abnormality, a detection state is not caused even if an abnormality exists. Thus the detection light L from the light emitting element 124 to the light receiving element 123 is slanted slightly with respect to the tangent 125.

[0035] The light emitting element 124 and light receiving element 123 are linked as a unit by the bracket 128. Specifically, the bracket 128 spanning the drive drum 108 in the axial direction on the outside of the cover (27 of Figure 1) arranged on the front side F of the drive drum 108 is mounted on the main body frame 135 of the winding unit 101 and the light emitting element 124 and light receiving element 123 are arranged either side of that bracket 128.

[0036] As shown in Figure 1, the cover 27 is a plate having an arc-shaped cross section arranged in close proximity to the peripheral surface of the drive drum 8 (108) and prevents end missing.

[0037] As shown in Figure 6, the bracket 128 comprises a connector part spanning both ends of the drive drum 108 and following the lower end of the cover (27 of Figure 1), a standing part positioned on each end of the drive drum 108 and which projects from the curve of the cover (27 of Figure 1), and a seat part for fixing the light emitting element 124 and light receiving element 123. After the light emitting element 124 and light receiving element 123 are embedded and fixed in this seat part and unified, mounting is simplified and alignment of the optical axes is unnecessary by mounting the light emitting element 124 and light receiving element 123 together with the bracket 128 on the main body frame 135 of the winding unit 101.

[0038] The positioning of the light emitting element 124 and light receiving element 123 may be on either side of the drive drum 108 from the point of linear properties and symmetrical properties of the light but in the present embodiment, the light emitting element 124 is positioned on the small diameter side of of the package P. This positioning is particularly convenient for detection of end missing. The light emitting element 124 is positioned on the small diameter side of of the package P utilizing the characteristic whereby end missing easily occurs on the small diameter side of the package P and the characteristic whereby sensitivity to yarn is higher at a position closer to the light emitting element 124 than a position far from it as the luminous flux of the detection light L from the light emitting element 124 gradually dis-

perses. Due to this, end missing is reliably detected.

[0039] Furthermore, in the present embodiment, the light emitting element 124 is positioned on the free end of the drive drum 108. The drive drum 108 is supported on one side only by the main body frame 135 of the winding unit 101, and the light receiving element 123 is positioned on this fixed side and the light emitting element 124 is positioned on the opposite free side. This is because, with the positioning of the light emitting element 124 close to the drive drum 108, if the light emitting element 124 is positioned on the fixed side of the drive drum 108, the main body frame 135 would be an obstacle in order to allow one part of the main body of the light emitting element 124 to be hidden by the drive drum 108. As there is no interfering member on the free side, the positioning of the light emitting element 124 becomes free and mounting is simplified.

[0040] If the fixed side of the drive drum 108 is the large diameter side and the free side is the small diameter side, as the free side of the drive drum 108 inevitably becomes the small diameter side of the package P, the light emitting element 124 may be positioned on the small diameter side of the package P and on the free side of the drive drum 108.

[0041] Figure 8 shows a second embodiment of the present invention. A light emitting device 224 is formed as a cylindrical housing 241 that contains a light emitting element 224a in the base, a first aperture 242 with a spherical slit that restricts the luminous flux from the light emitting element to a round shape and a second aperture 243 with a flat rectangular slit 243 that restricts that luminous flux to a flat shape. The light emitting element emits infrared light or visible red light and a convex lens is not attached to that light emitting part. The diameter of the spherical slit 242 is 0.5-1mm and the short side of the rectangular slit 243 is 0.2-0.5mm. These dimensions are determined by the count (thickness) of the yarn Y and the detection distance. The light receiving element 223a of the light receiving device 223 is a high sensitivity light receiving IC.

[0042] The reason for restricting the luminous flux by the slit is not only so that the scattering of detection light L to the surface of the drive drum 208 can be prevented but also due to the fact that, if the luminous flux from the light emitting element 224a is greater than the thickness of the yarn Y, the difference in the amount of received light due to the presence or absence of a yarn is reduced but by restricting the luminous flux, the difference is the amount of received light is increased by the yarn effectively interrupting the light. However, if the luminous flux is restricted too much, the amount of received light by which the light receiving element 223a effectively operates can not be maintained. Thus the aforementioned slit dimensions are determined.

[0043] The reason for the arrangement of a flat rectangular slit 243 is because, when the luminous flux is restricted to a flat shape and the yarn cuts across that flat luminous flux, when parallel with that flat luminous flux the difference in the amount of received light due to the presence or absence of yarn becomes conspicuous. The luminous flux restricted to a flat shape has a cross section 244 as shown by the striped section and produces a difference in the amount of received light if the propotion of area represented by the yarn with respect to that cross section 244 is great. Accordingly, in order to produce an effective construction for yarn detection when winding restarts after a double yarn end finding or end missing, it is preferable that the long side of the rectangular slit 243 is be parallel in the direction of the yarn pulled from the package P.

[0044] The reason for not attaching a convex lens to the light emitting element forming the light emitting element 224a is because, by restricting the converged light to a flat shape by a convex lens, the light axis of the light emitting device is greatly displaced due to the slight deviation of the directivity of a convex lens. Further, instead of a convex lens attached to the light emitting element, converging by the arrangement of other optics having a precise directivity means that comprising the yarn detection sensor 222 as a cheap structure is impossible. Accordingly, the present embodiment does not converge the dispersed light from the light emitting part of the light emitting element but directly illuminates the spherical and rectangular slits 242, 243. Due to this, the axis of light is determined only from the positional relationship between the light emitting element 224a and slits 242, 243 and no light axis variance occurs if the light receiving element 223a is arranged along the light axis of the light emitting element 224d.

[0045] The direction in which the aforementioned rectangular slit 243 is extended lengthways is a direction being approximately parallel with respect to abnormal yarn 34 shown in Figure 5B. Both the yarn 33 from double yarn end finding of Figure 4 or the yarn 34 of Figure 5 which has end missed definitely cross over the luminous flux at the restart of winding when parallel with that flat luminous flux. Accordingly, the amount of received light at that instant is conspicuously reduced and correct yarn detection is achieved.

Claims

1. A package quality inspection device provided with a yam detection sensor (123, 124) for detecting the existence of yarn positioned outside the outermost layer of a package (P) for example formed during a winding process by an auto winder having a yam piecing device, wherein the yam detecting sensor (123, 124) is arranged such that a detecting light passes along the side where the yarn (Y) is introduced onto the package (P)
   characterized in that
   the detecting light passes at a slant from a position close to the package drive drum (108) to a position at a predetermined distance therefrom.

2. A package quality inspection device as in claim 1, **characterized in that** the package (P) is cone shaped and a light emitting element (124) of the yarn detection sensor is positioned on the small diameter side of the package (P).

3. A package quality inspection device as in claim 2, **characterized in that** the package drive drum (108) is supported on one side and the light emitting element (124) is positioned on the free side of the package drum.

4. A package quality inspection device as in one of the claims 1 to 3, **characterized in that** the light emitting element (224a) has an aperture (242, 243) for restricting the detection light.

5. A package quality inspection device as in claim 4, **characterized in that** the aperture is formed by a flat rectangular slit (243).

6. A package quality inspection device as in claim 5, **characterized in that** the aperture is additionally formed by a spherical slit (242).

7. A package quality inspection as in one of the claims 4 to 6, **characterized in that** the light from the light emitting element (224a) is directly passed through the aperture (242, 243).

Patentansprüche

1. Auflaufspulen-Qualitätsprüfvorrichtung mit einem Fadenprüfsensor (123, 124) zur Ermittlung des Vorhandenseins eines Fadens, der außerhalb der äußersten Lage einer Auflaufspule (P) positioniert ist, die z. B. während eines Spulvorgangs durch einen Spulautomaten hergestellt wurde, der eine Fadenverbindungsvorrichtung hat, wobei der Fadenprüfsensor (123, 124) derart angeordnet ist, daß ein Prüflicht längs der Seite, an der der Faden (Y) auf die Auflaufspule (P) eingeführt wird, verläuft, **dadurch gekennzeichnet, daß** das Prüflicht schräg aus einer Position nahe der Auflaufspulen-Antriebstrommel (108) zu einer Position in einem bestimmten Abstand davon verläuft.

2. Auflaufspulen-Qualitätsprüfvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, daß** die Auflaufspule (P) konusförmig ist, und das ein Lichtemissionselement (124) des Fadenprüfsensors auf der Seite des kleinen Durchmessers der Auflaufspule (P) angeordnet ist.

3. Auflaufspulen-Qualitätsprüfvorrichtung nach Anspruch 2, **dadurch gekennzeichnet, daß** die Auflaufspulen-Antriebstrommel (108) auf einer Seite und das Lichtemissionselement (124) auf der freien Seite der Auflaufspulentrommel angeordnet ist.

4. Auflaufspulen-Qualitätsprüfvorrichtung nach einem der Ansprüche 1-3, **dadurch gekennzeichnet, daß** das Lichtemissionselement (224a) eine Öffnung (242, 243) zum begrenzen des Prüflichts hat.

5. Auflaufspulen-Qualitätsprüfvorrichtung nach Anspruch 4, **dadurch gekennzeichnet, daß** das die Öffnung ein flacher rechteckiger Schlitz (243) ist.

6. Auflaufspulen-Qualitätsprüfvorrichtung nach Anspruch 5, **dadurch gekennzeichnet, daß** das die Öffnung zusätzlich durch einen kugeligen Schlitz (242) gebildet ist.

7. Auflaufspulen-Qualitätsprüfvorrichtung nach einem der Ansprüche 4-6, **dadurch gekennzeichnet, daß** das Licht des Lichtemissionselements (224a) direkt durch die Öffnung (242, 243) verläuft.

Revendications

1. Un dispositif d'inspection de qualité de bobines avec un capteur de détection de fil (123, 124) pour détecter l'existence du fil positionné à l'extérieur de la couche la plus externe d'une bobine (P) par exemple pendant une procédure d'enroulement par un enrouleur auto aytant un dispositif de rattachage de fil où le capteur de détection de fil (123, 124) est disposé de sorte qu'une lumière de détection passe le long du côté où le fil (Y) est introduit sur la bobine (P) **caractérisé en ce que** la lumière de détection passe une déclivité depuis une position prés du tambour d'entraînement de bobine (108) à une position à une distance prédéterminée de celle-ci.

2. Un dispositif d'inspection de qualité de bobine selon la revendication 1, **caractérisé en ce que** la bobine (P) est en forme de cône et un élément d'émission de lumière (124) du capteur de détection de fil est positionné sur le côté de petit diamètre de la bobine

(P).

3. Un dispositif d'inspection de qualité de bobine selon la revendication 2, **caractérisé en ce que** le tambour d'entraînement de bobine (108) est supporté sur un côté et l'élément d'émission de lumière (124) est positionné sur le côté libre du tambour de bobine.

4. Un dispositif d'inspection de qualité de bobine selon l'une des revendications 1 à 3, **caractérisé en ce que** l'élément d'émission de lumière (224a) présente une ouverture (242, 243) pour restreindre la lumière de détection.

5. Un dispositif d'inspection de qualité de bobine selon la revendication 4, **caractérisé en ce que** l'ouverture est formée par une fente plate rectangulaire (243).

6. Un dispositif d'inspection de qualité de bobine selon la revendication 5, **caractérisé en ce que** l'ouverture est formée en plus par une fente sphérique (242).

7. Un dispositif d'inspection de qualité de bobine selon l'une des revendications 4 à 6, **caractérisé en ce que** la lumière provenant de l'élément d'émission de lumière (224a) traverse directement l'ouverture (242, 243).

FIG. 1

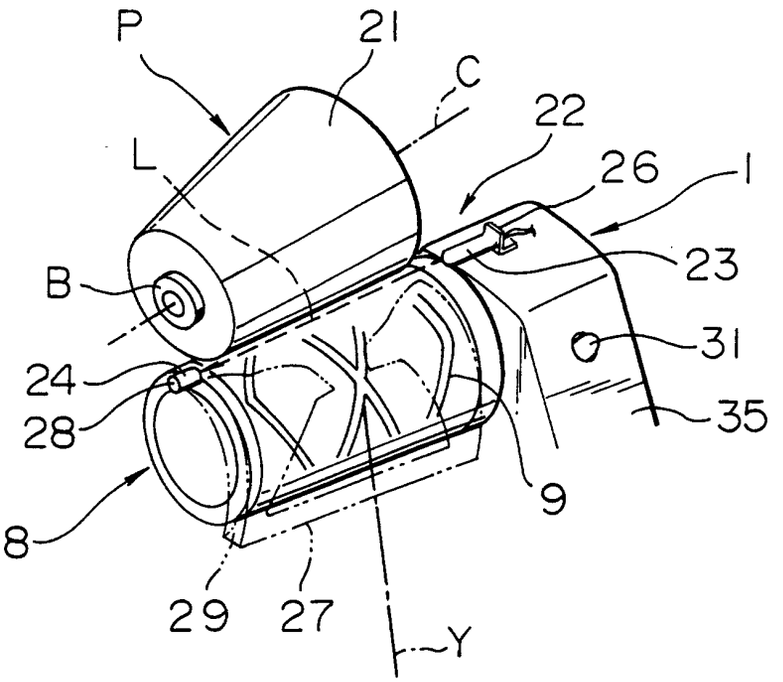

FIG. 2

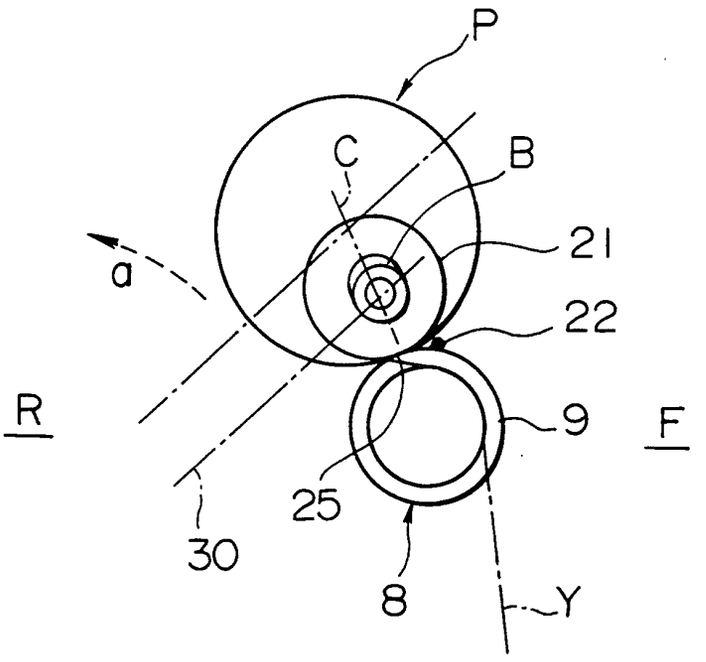

FIG. 3

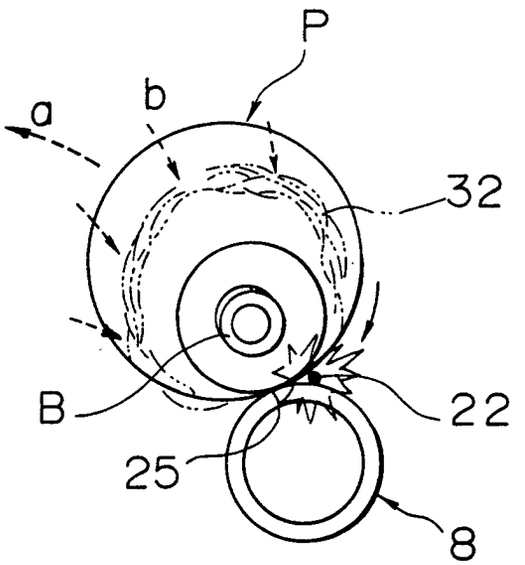

FIG. 4A

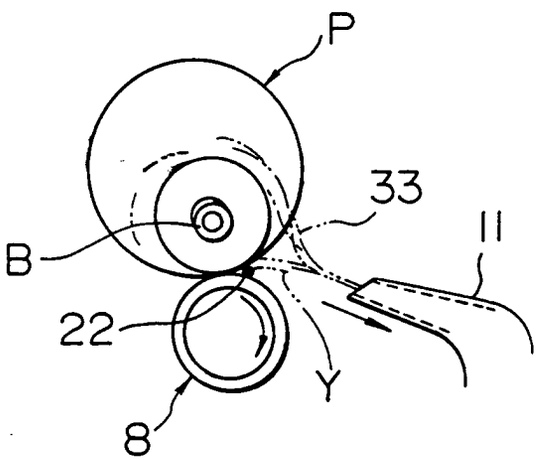

FIG. 4B

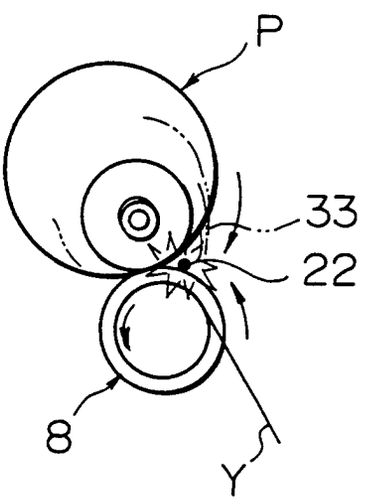

FIG. 5A

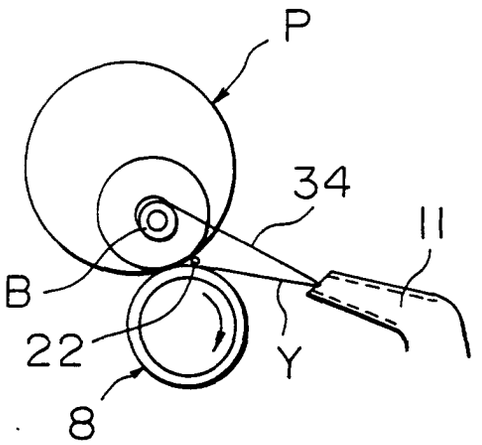

FIG. 5B

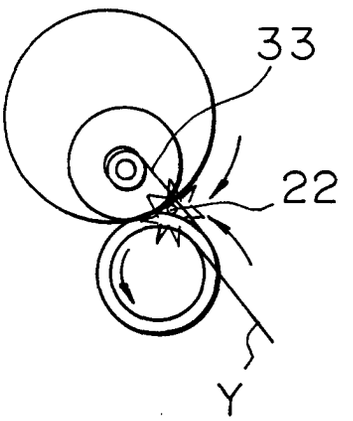

FIG. 6

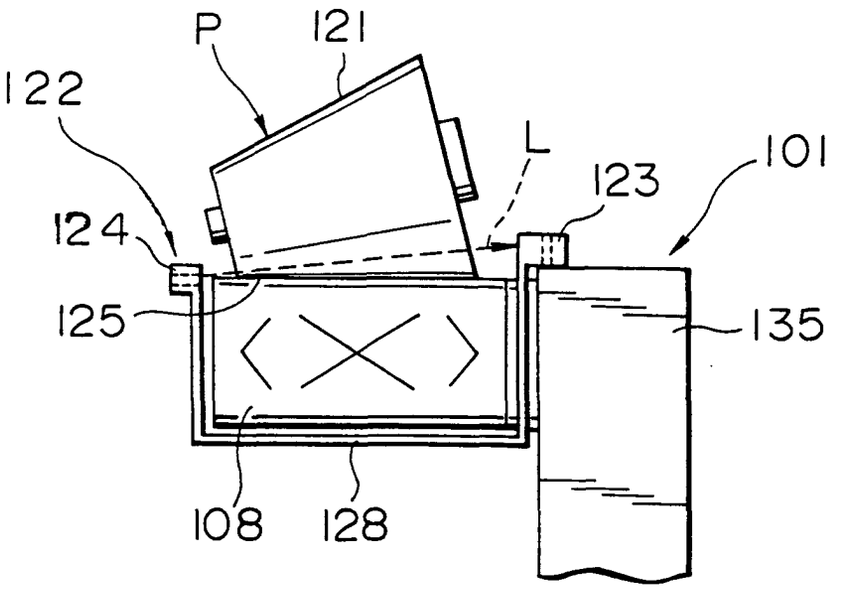

FIG. 7

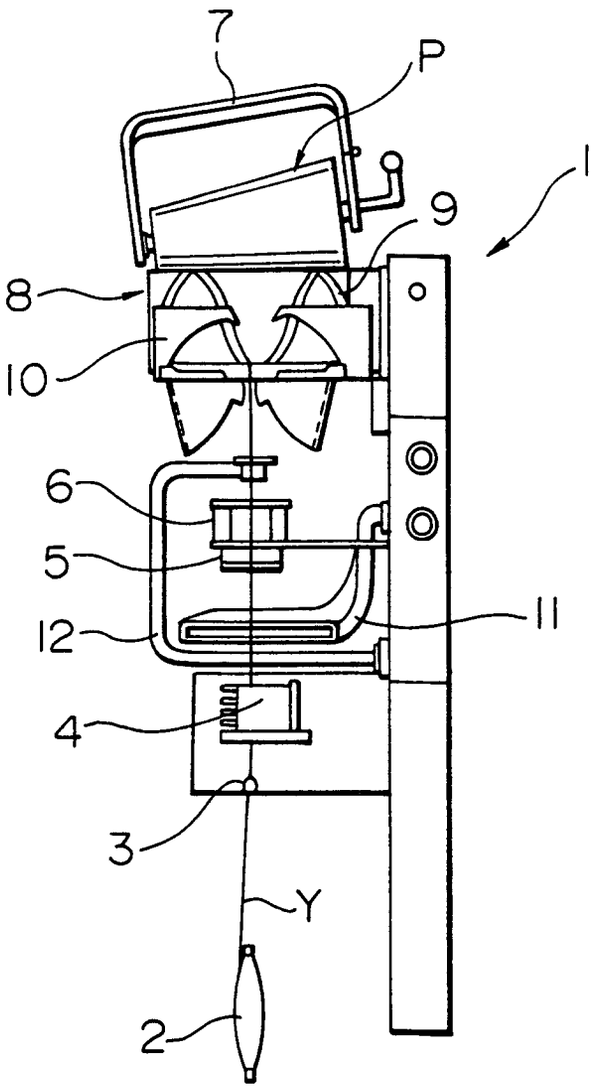

FIG. 8