

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 890 886 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

13.01.1999 Bulletin 1999/02

(51) Int Cl.⁶: **G03G 15/11**

(21) Application number: **98305449.5**

(22) Date of filing: **08.07.1998**

(84) Designated Contracting States:

**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**

Designated Extension States:

AL LT LV MK RO SI

(30) Priority: **10.07.1997 KR 9718235**

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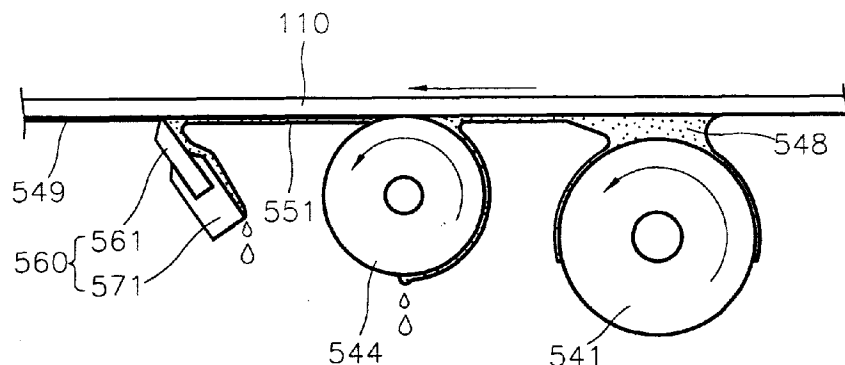
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(54) Development apparatus for liquid electrophotographic printer

(57) A development apparatus for a liquid electrophotographic printer includes a development roller (541) for supplying a developer liquid (548) to a development region of a photoreceptor belt (110) on which a latent electrostatic image is formed by being exposed to light, a squeegee roller (544) for forming a developer liquid film on the photoreceptor belt (110) by removing the ex-

cess developer liquid of the developer liquid (548) sticking to the development region, and a wrap-around developer liquid removal means (560) having a cleaning blade (561) being in contact with both edges of the photoreceptor belt (110) beyond the development region for removing the developer liquid on both edges of the photoreceptor belt (110).

FIG. 6



Description

The present invention relates to an improved development apparatus for a liquid electrophotographic printer for effectively removing developer liquid remaining on the edges of a photoreceptor belt using a simplified wrap-around developer liquid removing unit.

An electrophotographic printer such as a laser printer employs a photosensitive medium such as a photoreceptor drum or a photoreceptor belt, on which a latent electrostatic image is formed.

The laser printer is largely divided into a wet laser printer and a dry laser printer according to the type of a toner used for developing. The developer liquid used in the liquid laser printer is a mixture of a toner having a predetermined color and a volatile liquid carrier.

Referring to Figure 1, a conventional development apparatus includes a photoreceptor belt 110 on an endless track, and first, second and third rollers 121, 122 and 123 for circulating the photoreceptor belt 110 around a given path. The third roller 123 is a driving roller driven by a driving motor (not shown) for rotating the photoreceptor belt 110, and the second roller 122 is a steering roller for preventing meandering by adjusting the torsion force of the photoreceptor belt 110. A charging station 135 for charging the photoreceptor belt 110 is positioned in the vicinity of the moving block of the photoreceptor belt 110 between the first and second rollers 121 and 122. In the moving block of the photoreceptor belt 110 between the second and third rollers 122 and 123, a plurality of laser scanning units (LSUs) 130 and a plurality of development devices 140 are alternately installed. Here, the plurality of LSUs 130 are for forming a latent electrostatic image on the photosensitive region of the photoreceptor belt 110 by irradiating laser beams onto the photoreceptor belt 110 according to an image signal for each color, and the plurality of development devices 140 are for developing the latent electrostatic image into a toner image by applying a developer liquid having a toner of a predetermined color mixed with a liquid carrier to the photosensitive region where the latent electrostatic image is formed.

The toner image is transferred to a sheet 126 by a transfer roller 124 while passing through between the first roller 121 and the transfer roller 124. The sheet 126 is fed between the transfer roller 124 and a pressing roller 125 contacting the transfer roller 124 under a constant pressure.

Referring to Figure 2, a development roller 141, a cleaning roller 142, and first and second squeegee rollers 144 and 146 are disposed on the upstream side of the development device 140, a colored developer liquid 148 is contained in the downstream side thereof. The development roller 141 applies the developer liquid 148 to the latent electrostatic image formed on the photoreceptor belt 110 and develops the latent electrostatic image into a toner image. The developer liquid 148 is supplied between the development roller 141 and the pho-

toreceptor belt 110 by a developer liquid supplier 143. The cleaning roller 142 removes the developer liquid 148 remaining on the surface of the development roller 141. The first and second squeegee rollers 144 and 146 remove excess developer liquid 148 remaining after being used in developing the latent electrostatic image. The developer liquid 148 sticking to the first and second squeegee rollers 144 and 146 is separated by blades 145 and 147 being in contact with the surfaces of the first and second squeegee rollers 144 and 146.

The developed toner image of the photoreceptor belt 110 passes through the first and second squeegee rollers 144 and 146 to then be formed as a thin-film-like toner image containing some liquid carrier. While passing through the third roller 123, the liquid carrier contained in the toner image is removed by a drying roller 171 heated by a heating roller 172. The drying roller 171 absorbs the liquid carrier remaining on the surface of the photoreceptor belt 110, and the liquid carrier absorbed into the drying roller 171 is evaporated by the heating roller 172 to then be recovered by a recovery unit internally provided in the apparatus.

Referring to FIGs. 3 and 4, the development roller 141 is maintained a predetermined distance apart from the photoreceptor belt 110 and coats the supplied developer liquid 148 to the photoreceptor belt 110 while rotating in the same direction as the travelling direction of the photoreceptor belt 110. At this time, the developer liquid 148 is coated on a development region having the same width as the development roller 141. The first squeegee roller 144 squeezes the developer liquid coated on the development region 115 to form a thin developer liquid film 149 corresponding to the latent electrostatic image. Here, part of the developer liquid is pushed to both edges of the photoreceptor belt 110 due to the squeegee action of the first squeegee roller 144. The developer liquid 151 on the edges of the photoreceptor belt 110 is removed by the second squeegee roller 146 rotating in the reverse direction to the travelling direction of the photoreceptor belt 110. During this procedure, the wrap-around developer liquid 151 sticking to the second squeegee roller 146 is separated by the second blade 147 being in contact with the second squeegee roller 147.

The first and second squeegee rollers 144 and 146 are rotated by a separately provided driving means, and come into and out of contact with the photoreceptor belt by an elevating means (not shown). Also, the blades 145 and 147 are installed corresponding to the first and second squeegee rollers 144 and 146. Thus, the overall system configuration is complicated. Thus, when the squeegee rollers 144 and 146 are worn or damaged, the system must be taken apart through a complicated procedure to be replaced with new ones.

As described above, since the conventional development apparatus has a complicated configuration, the disassembly or assembly procedure for repair or replacement of parts is not easy. Also, the cost for replace-

ment of parts such as squeegee rollers is expensive.

With a view to solve or reduce the above problem, it is an aim of preferred embodiments of the present invention to provide a development apparatus for a liquid electrophotographic printer, which has a simplified structure and can effectively remove excess developer liquid sticking to a photoreceptor belt.

According to a first aspect of the invention, there is provided a development apparatus for a liquid electrophotographic printer comprising: a development roller for supplying a developer liquid to a development region of a photoreceptor belt on which a latent electrostatic image is formed by being exposed to light; a squeegee roller for forming a developer liquid film on the photoreceptor belt by removing the excess developer liquid of the developer liquid sticking to the development region; and a wrap-around developer liquid removal means having a cleaning blade being in contact with both edges of the photoreceptor belt beyond the development region for removing the developer liquid on both edges of the photoreceptor belt.

The blade is preferably made of a soft elastomeric material.

The wrap-around developer liquid removal means may further comprise a bracket for supporting the cleaning blade.

The apparatus may further comprise: an elevating means for moving the wrap-around developer liquid removal means up and down so that the cleaning blade comes in and out of contact with the photoreceptor belt.

Preferably, the elevating means comprises: a driving device; a cam shaft rotated by the driving device; and a cam installed on the cam shaft for physically interfering with the wrap-around developer liquid removal means (560).

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figure 1 is a schematic diagram of a conventional development apparatus for a liquid electrophotographic printer adopting a photoreceptor belt as a photosensitive medium;

Figure 2 is a schematic diagram illustrating the internal structure of the conventional development apparatus shown in Figure 1;

Figure 3 is a partially exploded side view of the development apparatus shown in Figure 2;

Figure 4 is a partially exploded front view of the development apparatus shown in Figure 2;

Figure 5 is a schematic side view of a development apparatus for a liquid electrophotographic printer, according to the present invention;

Figure 6 is a partial side view illustrating the relationship between elements of the development apparatus shown in Figure 5 and a photoreceptor belt;

Figure 7 is a schematic perspective view of the development apparatus shown in Figure 5; and

Figure 8 is a partially exploded perspective view of a wrap-around developer liquid removing device adopting development apparatus according to an embodiment of the present invention.

Referring to FIGs. 5 and 6, a development roller 541 for applying a developer liquid 548 to a photoreceptor belt 110 on which a latent electrostatic image is formed by being exposed to light is positioned in the upper portion of a development apparatus 540 containing the developer liquid 548. Along the travelling direction of the photoreceptor belt 110, there are installed a squeegee roller 544 for removing excess developer liquid 548 sticking to the photoreceptor belt 110, and a wrap-around developer liquid removal means 560 having a photoreceptor belt cleaning blade 561 for removing the developer liquid remaining on both edges of the photoreceptor belt 110 beyond a development region, which is the main feature of the present invention.

The cleaning blade 561 of the wrap-around developer liquid removing apparatus 560 is supported by a bracket 571. The bracket 571 is elevated by an elevating means to be described later. Thus, the cleaning blade 561 is capable of contacting the photoreceptor belt 110 or being separated from the photoreceptor belt 110. To avoid the damage to the photoreceptor belt 110 due to friction, the photoreceptor belt cleaning blade 561 is preferably made of a soft elastomeric material.

A developer liquid supplier 543 for supplying a developer liquid between the development roller 541 and the photoreceptor belt 110 is provided at one side of the development roller 541. A cleaning roller 542 for removing the developer liquid 548 sticking to the surface of the development roller 541 is installed in the lower portion of the development roller 541. A squeegee roller cleaning blade 545 for removing the developer liquid 548 sticking to the surface of the squeegee roller 544 is installed on the downstream side of the squeegee roller 544. At one side of the development apparatus 540, that is, in the right side of the drawing, a laser scanning unit (LSU) 130 is installed for forming a latent electrostatic image by irradiating a laser beam onto the development region of the photoreceptor belt 110 travelling along an endless track.

The development roller 541 applies the developer liquid 548 supplied from the developer liquid supplier 543 to the development region on which the latent electrostatic image is formed. While the development roller 541 rotates, the development roller cleaning roller 542 provided in the lower portion of the development roller 541 cleans the development roller 541. Excess devel-

oper liquid sticking to the development region of the photoreceptor belt 110 is removed by the squeegee roller 544, and the developer liquid sticking to the squeegee roller 544 is removed by the squeegee roller cleaning blade 545 installed on the downstream side of the squeegee roller 544. The photoreceptor belt cleaning blade 561 comes in contact with the photoreceptor belt 110 by the above-described elevating means when cleaning is necessary, and comes out of contact with the photoreceptor belt 110 when cleaning is not necessary. The photoreceptor belt cleaning blade 561 of the wrap-around developer liquid removal means 560 contacts both edges of the photoreceptor belt 110 to remove the developer liquid present at both edges beyond the development region after passing through the squeegee roller 544.

During this procedure, only the toner image of a thin film pattern corresponding to the latent electrostatic image of the development region remains on the photoreceptor belt 110. The toner image contains some carrier, the carrier is absorbed into the drying roller 151 via the third roller 123, and the carrier absorbed into the drying roller 151 is heated by the heating roller 152 contacting the drying roller 151 to then be evaporated.

Referring to Figure 7, as described above, the developer liquid 548 sticking to the development region 115 of the photoreceptor belt 110 by the development roller 541 is removed, excluding the amount of the developer liquid necessary for development by the squeegee roller 544. At this time, the wrap-around developer liquid 551 carried to both edges 550 of the photoreceptor belt 110 by being squeegeed by the squeegee roller 544 is removed by the photoreceptor belt cleaning blade 561.

The elevating means for elevating the bracket 571 up and down includes a driving motor 591, a cam shaft 581 rotated by the driving motor 591, and a cam 582 installed on the cam shaft 581. The cam shaft 581 is provided under the bracket 571, and the cam 582 for moving the bracket 571 up and down by physically interfering with a support bar 572 of the bracket 571 while rotating is installed on the cam shaft 581. A cam shaft sprocket 583 is installed at one end of the cam shaft 581 so as to rotate in engagement with a motor sprocket 592 installed on the shaft of the driving motor 591.

To remove the wrap-around developer liquid 551 sticking to the photoreceptor belt 110, the driving motor 591 is driven to rotate the cam shaft 581. As the cam shaft 581 rotates, the bracket 571 engaged by the cam 582 ascends, and the developer liquid cleaning blade 561 ascends accordingly so as to make contact with the photoreceptor belt 110.

Referring to Figure 8, the developer liquid cleaning blade 561 is detachably installed relative to the bracket 571. To this end, an insertion slot 573 are formed on the bracket so that the developer liquid cleaning blade 561 can be inserted. Also, the developer liquid cleaning blade 561 is fixed by a screw 575 in a state where it is

inserted into the insertion slot 573 of the bracket 571. Thus, screw locking holes 562 and 574 are formed on the developer liquid cleaning blade 561 and the bracket 572, respectively.

As described above, since the development apparatus for a liquid electrophotographic printer according to embodiments of the present invention employs a developer liquid removal means having a blade for removing a wrap-around developer liquid, the wrap-around developer liquid can be effectively removed. Also, since the developer liquid removal means has a simplified structure, the worn blade can be replaced with a new one easily. Also, since a blade cheaper than the conventional squeegee roller is used, the cost for replacement of the developer liquid removal means is reduced.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

Claims

1. A development apparatus for a liquid electrophotographic printer comprising:

a development roller (541) for supplying a developer liquid (548) to a development region of a photoreceptor belt (110) on which a latent electrostatic image is formed by being exposed to light;

a squeegee roller (544) for forming a developer liquid film on the photoreceptor belt by removing the excess developer liquid of the developer liquid sticking to the development region; and

a wrap-around developer liquid removal means (560) having a cleaning blade (561) being in contact with both edges of the photoreceptor belt (110) beyond the development region for removing the developer liquid on both edges of the photoreceptor belt (110). 5

2. The development apparatus according to claim 1, wherein the blade (561) is made of a soft elastomeric material. 10

3. The development apparatus according to claim 1 or 2, wherein the wrap-around developer liquid removal means (560) further comprises a bracket (571) for supporting the cleaning blade (561). 15

4. The development apparatus according to claim 1, 2 or 3, further comprising:
an elevating means for moving the wrap-around developer liquid removal means up and down so that the cleaning blade comes in and out of contact with the photoreceptor belt. 20

5. The development apparatus according to claim 4, wherein the elevating means comprises: 25

a driving device (591);

a cam shaft (581) rotated by the driving device (591); and 30

a cam installed (582) on the cam shaft (581) for physically interfering with the wrap-around developer liquid removal means (560). 35

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FIG. 1

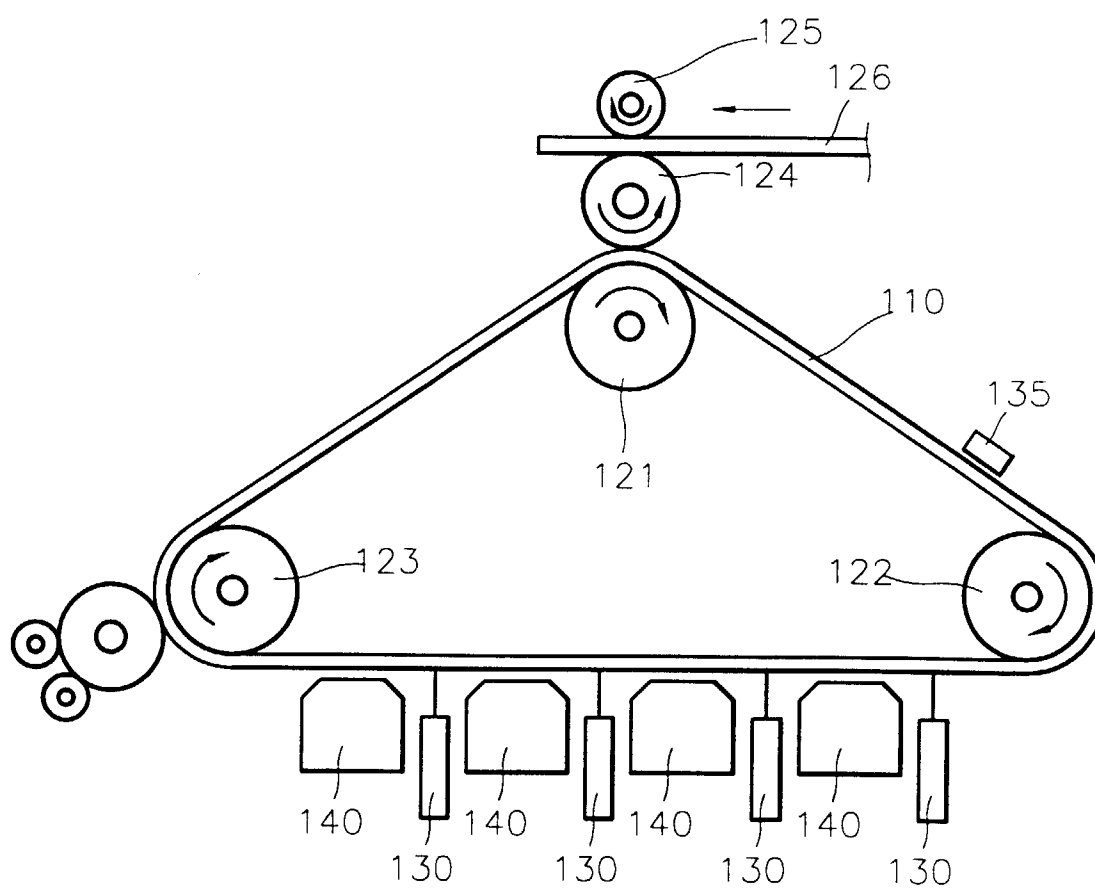


FIG. 2

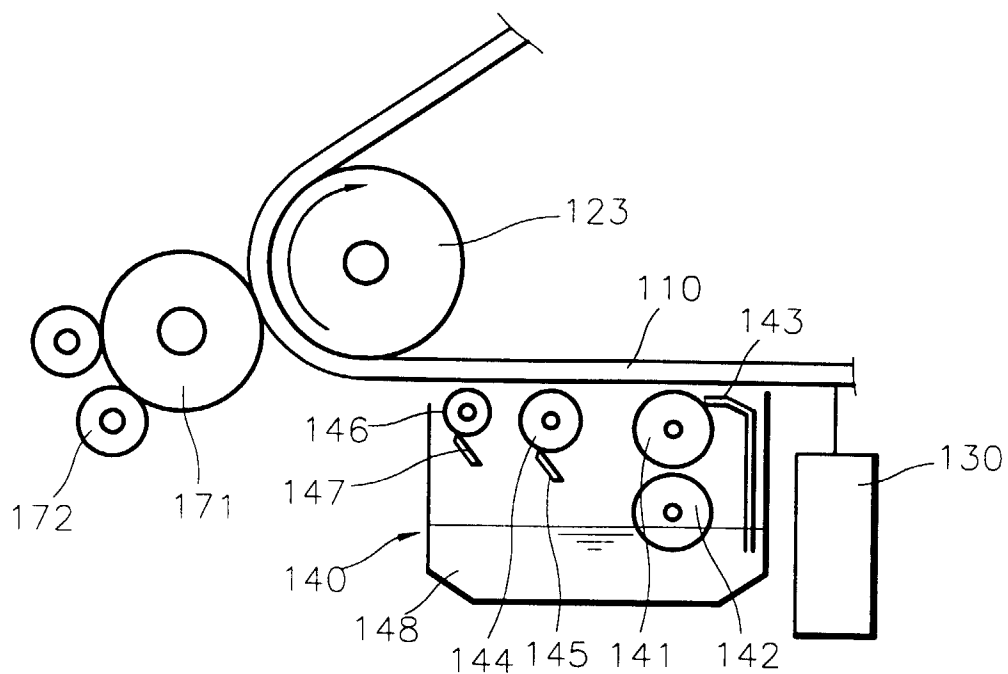


FIG. 3

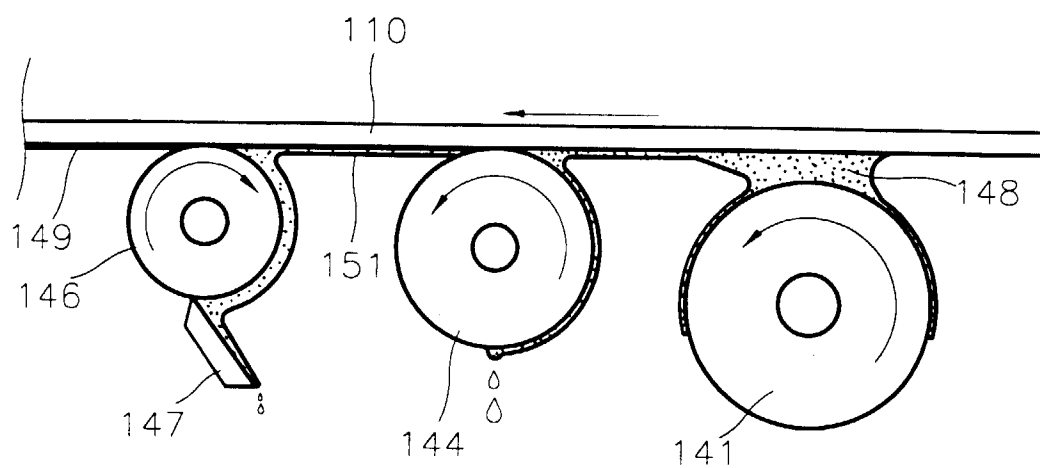


FIG. 4

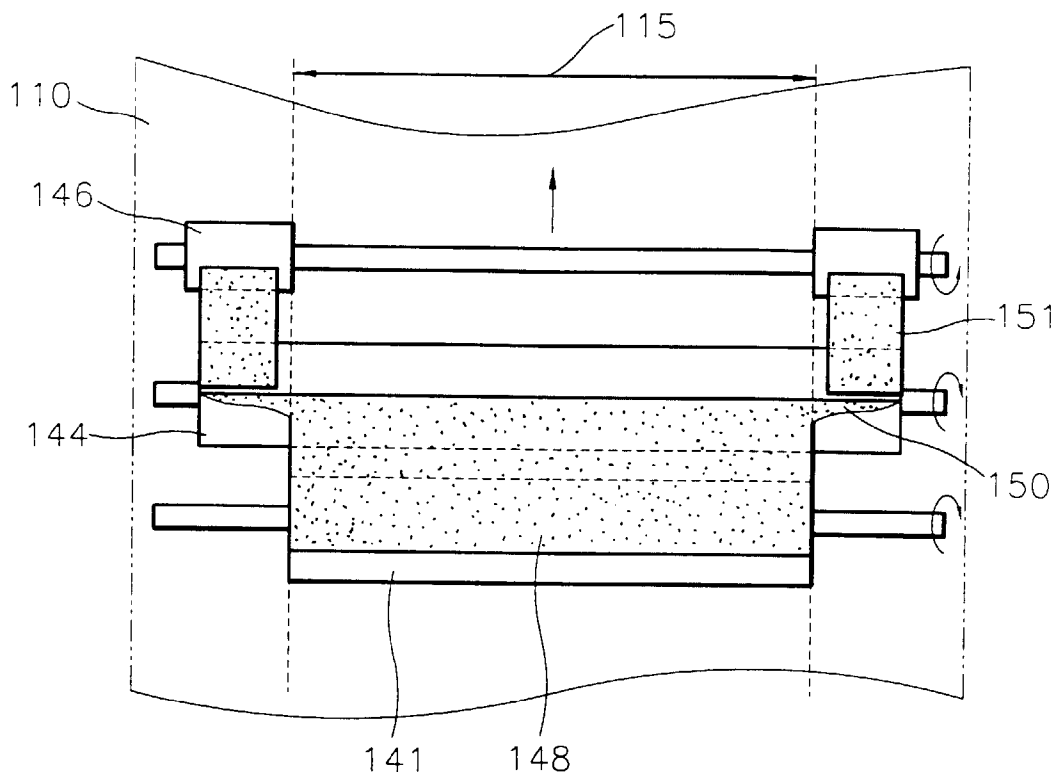


FIG. 5

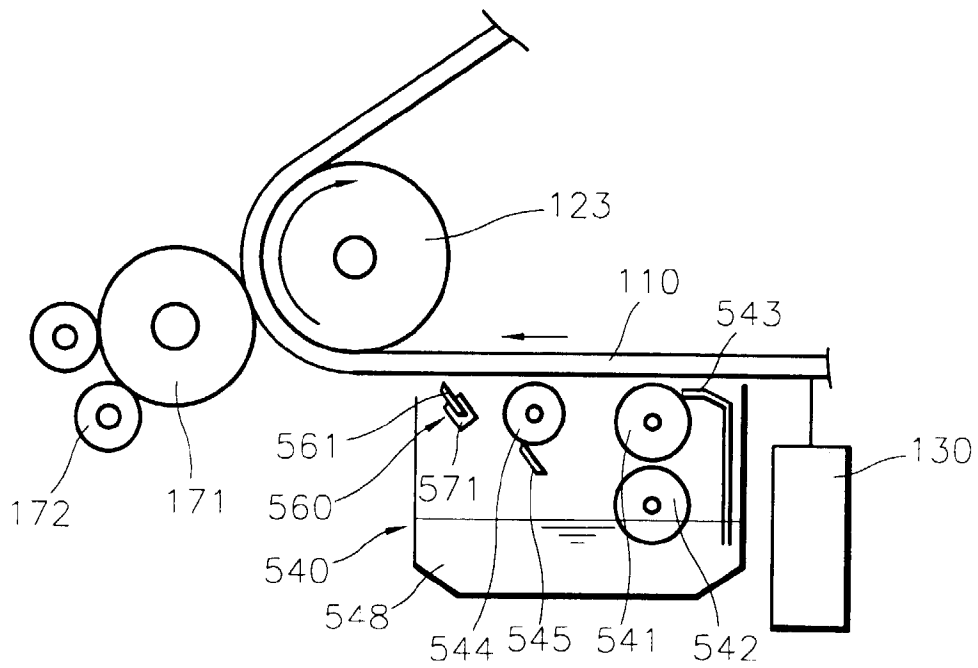


FIG. 6

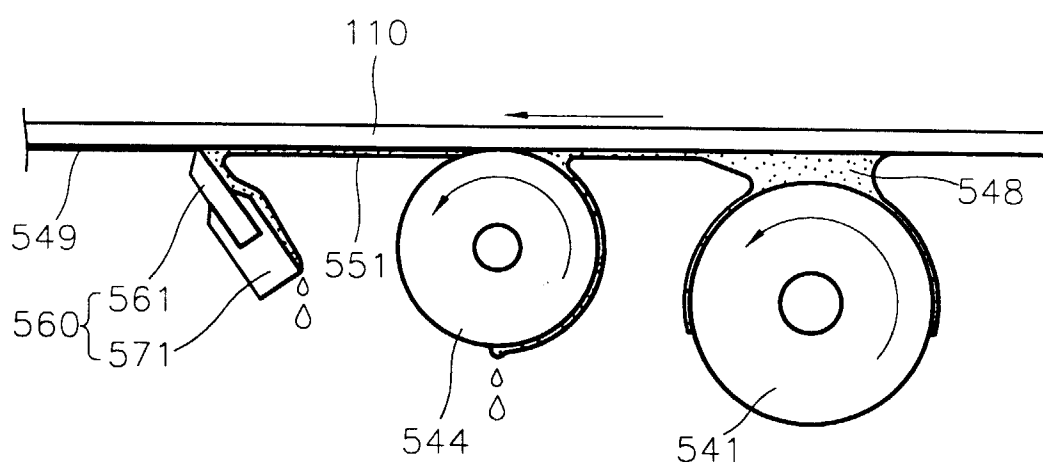


FIG. 7

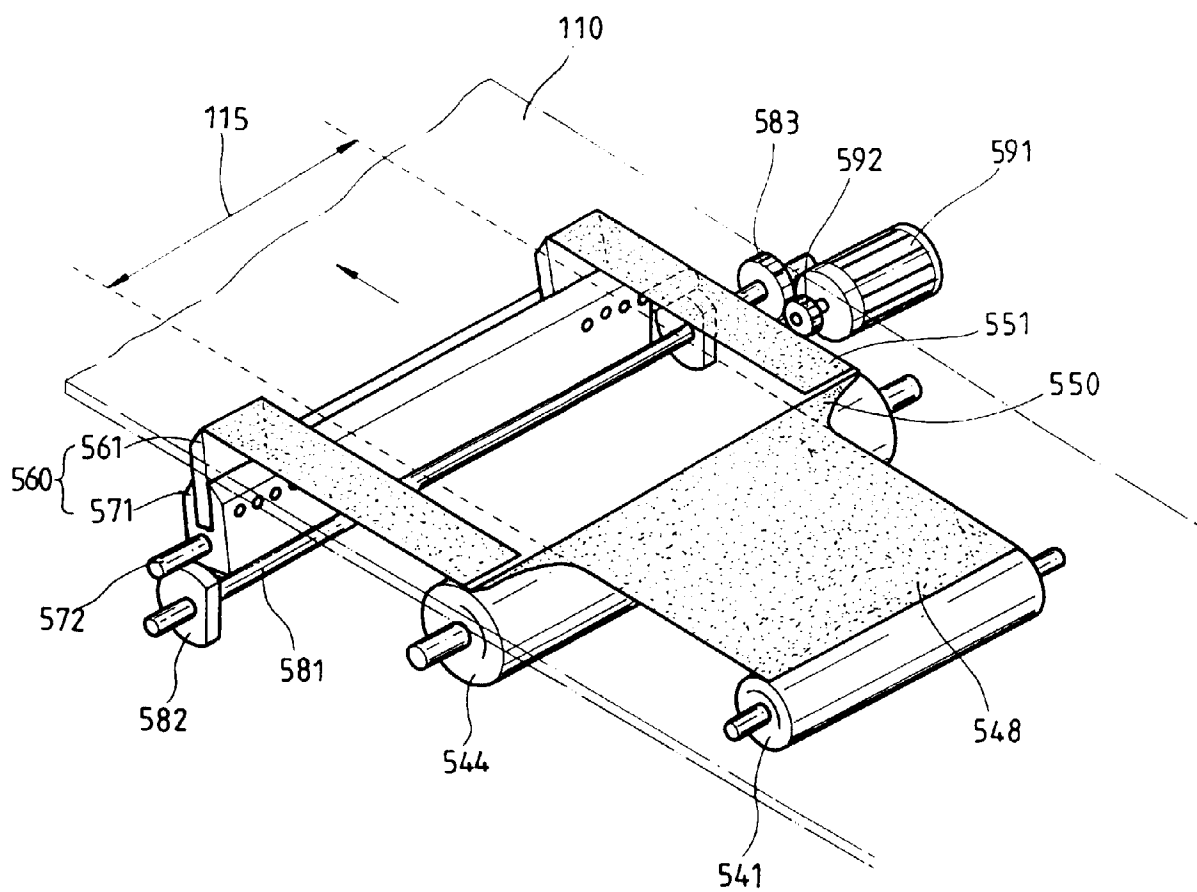
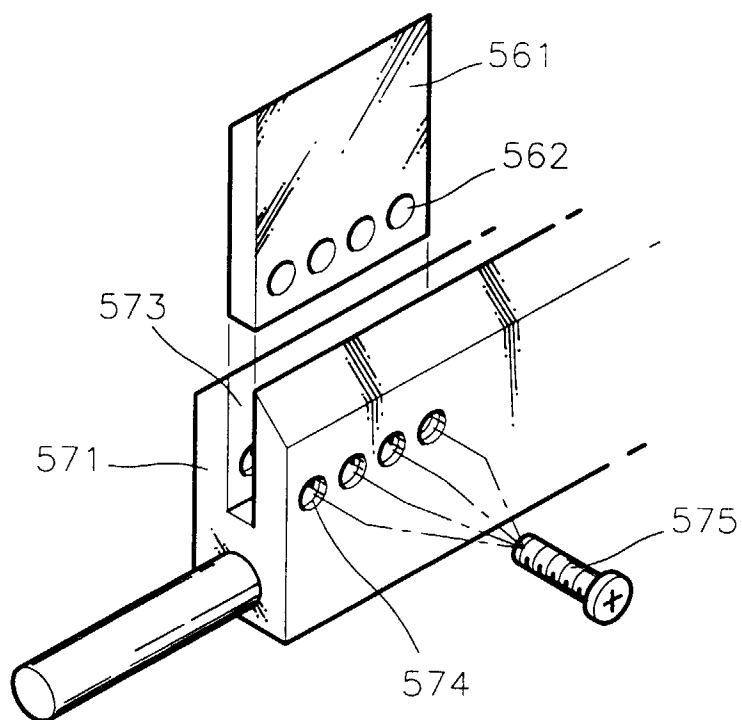


FIG. 8





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EUROPEAN SEARCH REPORT

Application Number
EP 98 30 5449

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	US 4 905 047 A (ARIYAMA KENZO) 27 February 1990 * figures 2,3 *	1-4	G03G15/11
A	WO 97 12290 A (IMATION CORP) 3 April 1997 * figures 1-3 *	1	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			G03G
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 20 October 1998	Examiner Hoppe, H
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