

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



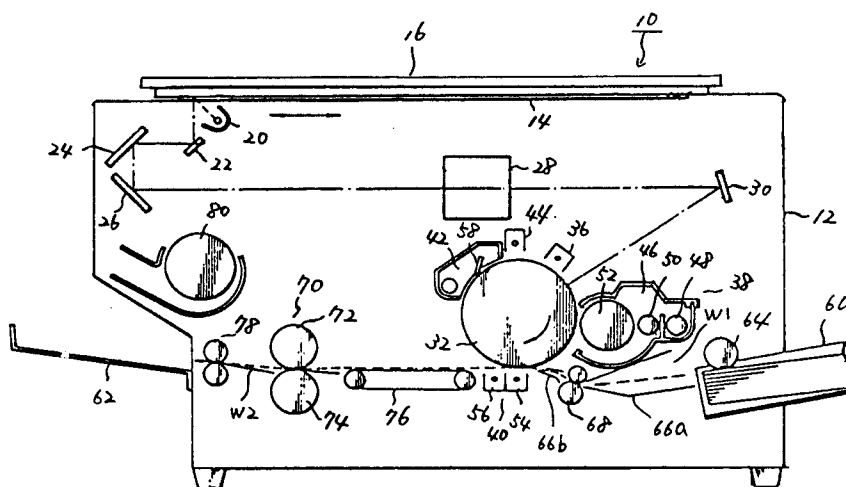
(11) Publication number:

0 526 018 A2

(12)

EUROPEAN PATENT APPLICATION(21) Application number: **92306261.6**(51) Int. Cl.⁵: **G03G 15/08**(22) Date of filing: **08.07.92**(30) Priority: **31.07.91 JP 191406/91**(43) Date of publication of application:
03.02.93 Bulletin 93/05(84) Designated Contracting States:
DE FR GB(71) Applicant: **KABUSHIKI KAISHA TOSHIBA**
72, Horikawa-cho Saiwai-ku
Kawasaki-shi Kanagawa-ken Tokyo(JP)(72) Inventor: **Sugawara, Kayo, c/o Intellectual**
Property Division
Toshiba Corporation, 1-1-1 Shibaura
Minato-ku, Tokyo(JP)(74) Representative: **March, Gary Clifford**
Batchellor, Kirk & Co. 2 Pear Tree Court
Farringdon Road
London EC1R 0DS(GB)(54) **Image forming apparatus including a developing device for developing a latent image.**

(57) An image forming apparatus (10) for forming an image on an image bearing member (32) includes a developing unit (38) for developing a latent image formed on the image bearing member (32). The developing unit (38) includes a developing roller (52) for transporting a developer to the image bearing member (32), a blade (58) for forming a layer of the developer on the developing roller (52) and a preventing member for covering the layer of the developer formed on the developing roller so as to prevent the developer from leaking outside the developing unit. By a simple construction, the image forming apparatus of the present invention prevents developer from leaking outside the developing unit when the developer is mechanically scraped up by a blade and is transported to the image bearing member by the developing roller.

**FIG. 1****EP 0 526 018 A2**

1. Field of the Invention

The present invention is concerned with image forming apparatus, such as an electrophotographic copying machine, having a developing device for developing a latent image formed on an image bearing member, such as a photosensitive drum.

US-A-4,342,822 discloses a prior art developing device for use with a image forming apparatus, such as an electrophotographic copying machine. The developing device includes a developing roller for supplying a developer to a image bearing member, such as a photosensitive drum, and a coating blade for forming a coated layer of the developer on the surface of the developing roller.

In conventional developing devices, developer becomes scattered on the inside of the image forming apparatus with use. More specifically, the coated layer of developer formed on the developing roller by the blade may leak outside the developing device when the developer is mechanically scraped up by the blade and is transported to the photosensitive drum.

Conventional image forming apparatus would be soiled by the developer scattered therein, and would produce images of a poor quality. Conventional image forming apparatus thus require a developer collection filter for collecting and removing scattered developer. However, the developer collection filter cannot collect and remove all the scattered developer from the apparatus. Additionally, while in the art of image forming apparatuses, there is a need to reduce the size of an apparatus into a more compact housing, the use of a developer collection filter increases the size requirements of an image forming apparatus.

It is an object of the present invention to provide a image forming apparatus that can prevent developer from leaking outside a developing device.

It is another object to provide an image forming apparatus that can prevent developer leakage by a simple construction.

It is yet another object of the present invention to provide an image forming apparatus which is relatively compact in size without impairment to the quality of images produced thereby.

Accordingly, the foregoing objectives, as well as others, are achieved by the present invention, which provides an image forming apparatus for forming an image on a image bearing member. The image forming apparatus includes a latent image forming unit for forming a latent image on the image bearing member and a developing unit for developing the latent image formed on the image bearing member. The developing unit has a developing roller for transporting a developer to the image bearing member, a blade for forming a layer of the developer on the developing roller and a preventing member for covering the layer of the developer formed on the developing roller so as to prevent the developer from leaking outside the developing unit.

A further aspect of the present invention provides a developing device for developing a latent image formed on a image bearing member in an image forming apparatus. The developing device includes a container for storing a developer, a developing roller for transporting the developer stored in the container to the image bearing member, a blade for forming a layer of the developer on the developing roller and a preventing member for covering the layer of the developer formed on the developing roller so as to prevent the developer from leaking outside the developing unit.

A more complete appreciation of the present invention and many of its attendant advantages will be readily obtained as the invention becomes better understood by reference to the following detailed description of embodiments by way of non-limiting example only when considered in connection with the accompanying drawings, wherein:

Figure 1 is a sectional view of a image forming apparatus according to the present invention;

Figures 2(a) and 2(b) are sectional views of a developing device of the image forming apparatus shown in Figure 1; and

Figure 3 is a plan view of a developing roller and a preventing member of the developing device shown in Figures 2(a) and 2(b).

In the following detailed description, like reference numerals will be used to denote like elements in Figures 1 to 3. Figure 1 shows an image forming apparatus according to the present invention. The image forming apparatus may be, of course, one of a wide variety known in the prior art. For purpose of example, however, the image forming apparatus depicted is an electrophotographic copying machine 10.

Copying machine 10 includes a housing 12. A document table 14 and a document cover 16 are provided on the upper surface of housing 12. Document table 14 is formed of a transparent glass. During use, document cover 16 is lifted away from document table 14 in order to place an original document on document table 14.

Copying machine 10 also includes a scanning unit 18 for optically scanning an original document set on document table 14. Scanning unit 18 includes an exposure lamp 20 for emitting light onto an original

document set on document table 14. Light emitted from exposure lamp 20 is reflected by the original document and is directed to an image bearing member, for example, a photosensitive drum 32, through first, second and third reflecting mirrors 22, 24 and 26, a variable magnification lens block 28 and a fourth reflecting mirror 30. Exposure lamp 20 and first reflecting mirror 22 are mounted on a first carriage (not shown). Thereby, exposure lamp 20 and first reflecting mirror 22 reciprocally move between both end portions of document table 14 in the lengthwise direction so as to scan an image on the original document. Second and third reflecting mirrors 24 and 26 are mounted on a second carriage (not shown). The second carriage moves through a distance which is half of the traveling distance of the first carriage. Variable magnification lens block 28 can move along an optical axis to provide for the image forming magnification.

Copying machine 10 includes an image forming unit 34 for forming an image on a recording medium, for example, a paper sheet P, corresponding to the image read by scanning unit 18. Image forming unit 34 includes photosensitive drum 32 for forming a latent image in response to light on the surface thereof. Photosensitive drum 32 is disposed substantially in the center of housing 12 and is formed, for example, of an organic photoconductor (OPC). Photosensitive drum 32 is rotated by an electric motor (not shown) in the direction of arrow A.

Image forming unit 34 also includes a charging unit 36, a developing unit 38, an image transfer unit 40, a cleaning unit 42 and a discharging lamp 44 which respectively are arranged around the periphery of photosensitive drum 32 in the direction of its rotation.

Charging unit 36 charges the entire surface of photosensitive drum 32 to a uniform level of charge in order to prepare the surface for forming a latent image.

Developing unit 38 develops the latent image formed on photosensitive drum 32 with a toner in order to form a toner image. Developing unit 38 includes a container 46, which contains a two-element developer having a toner and a toner carrier. Container 46 includes first and second stirrers 48 and 50 for mixing the toner and the toner carrier together. Developing unit 38 also has a developing roller 52 for transporting the mixture of toner and toner carrier to a developing position or station facing the surface of photosensitive drum 32.

Image transfer unit 40 transfers the toner image onto paper sheet P. Image transfer unit 40 includes first and second chargers 54 and 56. First charger 54 faces photosensitive drum 32 at an image transfer position and charges paper sheet P so as to transfer the toner image formed on photosensitive drum 32 to paper sheet P. Second charger 56 charges paper sheet P so as to separate paper sheet P from photosensitive drum 32.

Cleaning unit 42 removes residual toner from photosensitive drum 32 after transfer of the toner image by image transfer unit 40. Cleaning unit 42 includes an elastic blade 58 which contacts the surface of photosensitive drum 32 so as to scrape the residual toner from the surface of photosensitive drum 32.

Discharging lamp 44 radiates the surface of photosensitive drum 32 in order to set the electrical potential of the surface of photosensitive drum 32 to a uniform level.

A paper supply cassette 60 is inserted into a lower portion of housing 12. Cassette 60 holds a supply of paper sheets P. An output tray 62 is located on a outside portion of housing 12 to receive printed paper sheets P that are output from copying machine 10.

A pickup roller 64 for picking up individual paper sheets P from paper supply cassette 60 is provided at the top end of cassette 60 when cassette 60 is inserted into housing 12. Paper sheet P, when picked up from paper supply cassette 60, is then transported to photosensitive drum 32 through a feeding path W1. Feeding path W1 includes feeding guides 66a and 66b and a pair of aligning rollers 68.

A fixing unit 70 is located downstream of the image transfer position. Fixing unit 70 fixes a toner image onto paper sheet P by heating and pressing paper sheet P with the toner image. Fixing unit 70 has a heating roller 72, a pressing roller 74 for pressing against heating roller 72, and a cleaner (not shown) for cleaning the surface of heating roller 72.

A paper transfer path 76 is located between the image transfer position and fixing unit 70. Paper sheet P from the image transfer position is transported to fixing unit 70 along paper transfer path 76. An eject path W2 is located downstream of fixing unit 70. Eject path W2 ejects paper sheet P with the fixed toner image into output tray 62. Eject path W2 includes a pair of eject rollers 78. An exhaust fan 80 is located above eject path W2 so as to prevent excess heating inside housing 12.

Referring to Figures 2 and 3, the details of developing unit 36 will now be described. As detailed above, developing unit 38 includes container 46 which contains the two-element developer having the toner and the toner carrier. Developing unit 38 develops a latent image on photosensitive drum 32 by using the two-element developer. Container 46 includes first and second stirrers 48 and 50 for mixing the toner and the toner carrier together.

Developing unit 38 also includes developing roller 52 for transporting the mixture of toner and toner

carrier to the developing position facing the surface of photosensitive drum 32. Preferably, a space gap of approximately 0.6 mm is maintained between photosensitive drum 32 and developing roller 52. Developing roller 52 includes a magnetic roller 82 and a non-magnetic sleeve 84 slipped over the periphery of magnetic roller 82. Magnetic roller 82 has a plurality of magnets (not shown) therein.

As shown in Figure 3, magnetic roller 82 has a width of, for example, 304 mm. Non-magnetic sleeve 84 has a diameter of, for example, 38 mm and a width of, for example, 322 mm. Non-magnetic sleeve 84 is rotated by a main motor (not shown) in the direction of arrow B (see Figure 2(a)) while magnetic roller 82 is fixed. First and second stirrers 48 and 50 are also rotated by the main motor.

Referring again to Figures 2(a) and 2(b), developing unit 38 includes a coating blade 86 for forming a coated layer of the developer 90 (herein referred to as a "magnetic brush") on the surface of developing roller 52. Blade 86 is formed of a non-magnetic material, for example, aluminum, and has a width of, for example, about 300 mm. Preferably, a space gap of approximately 0.55 mm is maintained between developing roller 52 and blade 86. Developing unit 38 also includes a preventing member 88 for preventing the developer of magnetic brush 90 from leaking outside developing unit 38. Preventing member 88 includes a L-shaped member having a first portion 88a and a second portion 88b (see Figure 2(a)). First portion 88a is attached to the rear surface of blade 86. Second portion 88b covers magnetic brush 90 formed on the surface of developing roller 52 so as to prevent the developer from leaking outside developing unit 38. Preventing member 88 is formed of a conductive elastic member, for example, polystyrene, polyisobutylene or the like. Preferably, preventing member 88 has a thickness of about 0.05 mm to 0.1 mm and a width of, for example, 325 mm. Second portion 88b of preventing member 88 has a length of about 12 mm to 25 mm. Second member 88b attached on blade 86 is curved along the wall of container 46 such that second portion 88b may cover magnetic brush 90 formed on the surface of developing roller 52 for a distance of about 12 mm to 25 mm from blade 86 (see Figure 2(b)). Thus, preventing member 88 prevents the developer of magnetic brush 90 from leaking outside developing unit 38 when the developer is mechanically scraped by blade 86 and is transported to photosensitive drum 32 by developing roller 52.

The image forming operation of copying machine 10 will now be described in detail with reference to Figures 1 and 3. A copying machine operator sets a original document on document table 14 and designates the various operating parameters, i.e., the number of paper sheets P to be copied, the reduce/enlarge rate, the copy contrast and so on. After a copy key on a operation panel (not shown) is depressed, scanning unit 18 emits light onto the original document so as to read an image formed on the original document.

The peripheral surface of photosensitive drum 32 is charged by charging unit 36. Then, the charged area is exposed to the light reflected from the original document. As a result, a latent image is formed on the surface of photosensitive drum 32, which rotates in the direction of arrow A. The formed latent image is transported to the developing position facing developing unit 38. The latent image formed on photosensitive drum 32 is then developed by the developer supplied by developing roller 52.

More specifically, in developing unit 52, first and second stirrers 48 and 50 mix the toner and the toner carrier together so as to form the developer, and transport the developer to developing roller 52. The developer transported to developing roller 52 is mechanically scraped up by blade 86 such that magnetic brush 90 having a width of about 297 mm and a thickness of about 0.55 mm is formed on the surface of developing roller 52. Magnetic brush 90 on the surface of developing roller 52 is covered with second portion 88b of preventing member 88 along the surface of developing roller 52. Thus, the developer of magnetic brush 90 may be transported to the developing position and does not leak outside developing unit 38.

After the developing process, the developed image is transported to the image transfer position, which faces image transfer unit 40. At the same time, paper sheet P from paper supply cassette 60 is fed through feeding path W1. Image transfer unit 40 has first charger 54, which is located on the image transfer position, for charging on paper sheet P. Thereby, the developed image formed on photosensitive drum 32 is transferred onto paper sheet P at the image transfer position. Image transfer unit 40 has second charger 56 for charging paper sheet P so as to separate paper sheet P from photosensitive drum 32.

After the image transfer process, paper sheet P is conveyed to Fixing unit 70 through paper transfer path 76 and the developed image is fixed on paper sheet P. Paper sheet P with fixed image is transported to output tray 62 through eject path W2.

The latent image and a residual toner image remain on photosensitive drum 32 after the image transfer process and they are transported to the area which faces cleaning unit 42. Cleaning unit 42 removes residual toner from photosensitive drum 32 after transfer of the toner image by image transfer unit 40. Cleaning unit 42 has an elastic blade 58 which contacts the surface of photosensitive drum 32 so as to

scrape the residual toner from the surface of photosensitive drum 32. The surface of photosensitive drum 32 is radiated by discharging lamp 44 so that the latent image remaining on photosensitive drum 32 is discharged.

The following test was performed on the image forming apparatus of the present invention. Two different copying machines were operated a predetermined number of times under the same conditions. Copying machine 1 was a copying machine of the present invention, including a preventing member 88. Copying machine 2 did not include a preventing member 88. After the copying machines were operated, the amounts of toner that had leaked from the respective developing units of copying machines 1 and 2 were measured. Specifically, the developing units stored a developer including a toner which had an average particle size of about 11.0 μm . The non-magnetic sleeves 84 were rotated at about 250 mm/sec and the photosensitive drums 32 were rotated at 125 mm/sec. The results of the test are indicated in TABLE 1, as shown below.

TABLE 1

	Number of copies	Amount of toner (mg)	
		Front side of copying machines 1 and 2 (adjacent front cover)	Rear side of copying machines 1 and 2
Copying machine 1	72,000	5	5
Copying machine 2	1,000	50	50

After producing 1,000 copies, about 50 mg of developer was measured on both the front side and the rear side of copying machine 2. Notably, because of the toner scattered in the inside of copying machine 2, after only 1,000 copies, image quality was poor. In comparison, after 72,000 copies were produced by copying machine 1, only about 5 mg of developer was measured on both the front side and the rear side of that copying machine. Thus, the amount of toner scattered on the inside of copying machine 1 was markedly less than that in copying machine 2. The copying machine of the present invention produces high-quality images, even after producing 72,000 copies.

Another test was performed to determine the minimum length of second portion 88b of preventing member 88. In this test, a copying machine of the present invention performed the image forming operation at 72,000 times under the above conditions. The test was performed with preventing members of differing lengths. After operating the copying machine, the amount of toner that had leaked from developing unit 38 was measured. TABLE 2, as shown below, indicates the results of the test.

TABLE 2

Length of 88b (mm)	10	11	12	13	14
Amount of toner (mg)	40	40	10	5	5

In this test, when the length of the second portion 88b of preventing member 88 was 11 mm or less, the amount of toner scattered on the inside of the copying machine was increased. In comparison, when the length of the second portion 88b of preventing member 88 was 12 mm or more, the amount of toner scattered on the inside of the copying machine greatly decreased. Thus, the minimum length of second portion 88b of preventing member 88 was determined to be about 12 mm.

As described above with regard to the present invention, copying machine 10 includes developing unit 38 having coating blade 86 for forming magnetic brush 90 on the surface of developing roller 52, and preventing member 88 for covering the magnetic brush 90 formed on the surface of developing roller 52 so as to prevent the developer of magnetic brush 90 from leaking outside developing unit 38. By a simple construction, copying machine 10 prevents developer from leaking outside developing unit 38 when the developer is mechanically scraped up by blade 86 and is transported to photosensitive drum 32 by developing roller 52. Thus, the present invention eliminates the need for a developer collection filter for collecting and removing scattered developer. Also, as is desirable in the art of copying machines, the present invention is relatively compact, yet is capable of producing quality images.

In the embodiment described above, preventing member 88 includes a L-shaped member having first

portion 88a and second portion 88b. Alternatively, however, preventing member 88 may be provided with, for example, a member formed in a shape generally matching the curvature of magnetic brush 90 formed on the surface of developing roller 52. In this case also, developer may be prevented from leaking outside developing unit 38 effectively.

5 Additionally, the kind of apparatus to which the present invention, including a developing unit 38 having a preventing member 88, is applicable, is not limited to an electrophotographic copying machine, but may be any image forming apparatus known in the art, for example, a laser printer or a facsimile apparatus.

10 It should be understood that the detailed description indicates the preferred embodiments of the present invention, and are given by way of illustration only. Various modifications and changes may be made to the present invention, without departing from the scope or spirit of the invention, as is set forth in the following claims.

Claims

- 15 1. An image forming apparatus useful in forming an image on an image bearing member, comprising:
 imaging means for forming a latent image on said image bearing member; and
 developing means for developing the latent image formed on said image bearing member, said
 developing means including roller means for transporting a developer to said image bearing member
 and blade means for forming a layer of the developer on said roller means, characterized in that;
 said developing means includes preventing means for at least partially covering the layer of the
 developer formed on said roller means so as to prevent the developer from leaking outside said
 developing means.
- 25 2. An apparatus according to claim 1, wherein said preventing means includes a conductive elastic member.
3. An apparatus according to claim 1 or 2, wherein the width of said preventing means exceeds that of said blade means.
- 30 4. An apparatus according to any preceding claim, wherein said preventing member includes a first portion attached to said blade means and a second portion for covering the layer of developer formed on said roller means.
- 35 5. An apparatus according to claim 4, wherein said second portion of said preventing means has a length of about 12 mm to about 25 mm and a thickness of about 0.05 mm to about 0.1 mm.
6. An apparatus according to claim 4 or 5, wherein said developing means includes a container for storing the developer; and
 wherein said second portion is curved along a wall of said container so as to cover the layer of
 developer formed on said roller means.
- 40 7. An image forming apparatus according to any preceding claim further comprising:
 supporting means for setting an original document;
 scanning means for optically scanning an image on the original document set on said supporting
 means;
 exposure means for forming a latent image corresponding to the image on the original document
 scanned by said scanning means on said image bearing member; and
 transfer means for transferring the image developed by said developing means onto a recording
 medium.
- 50

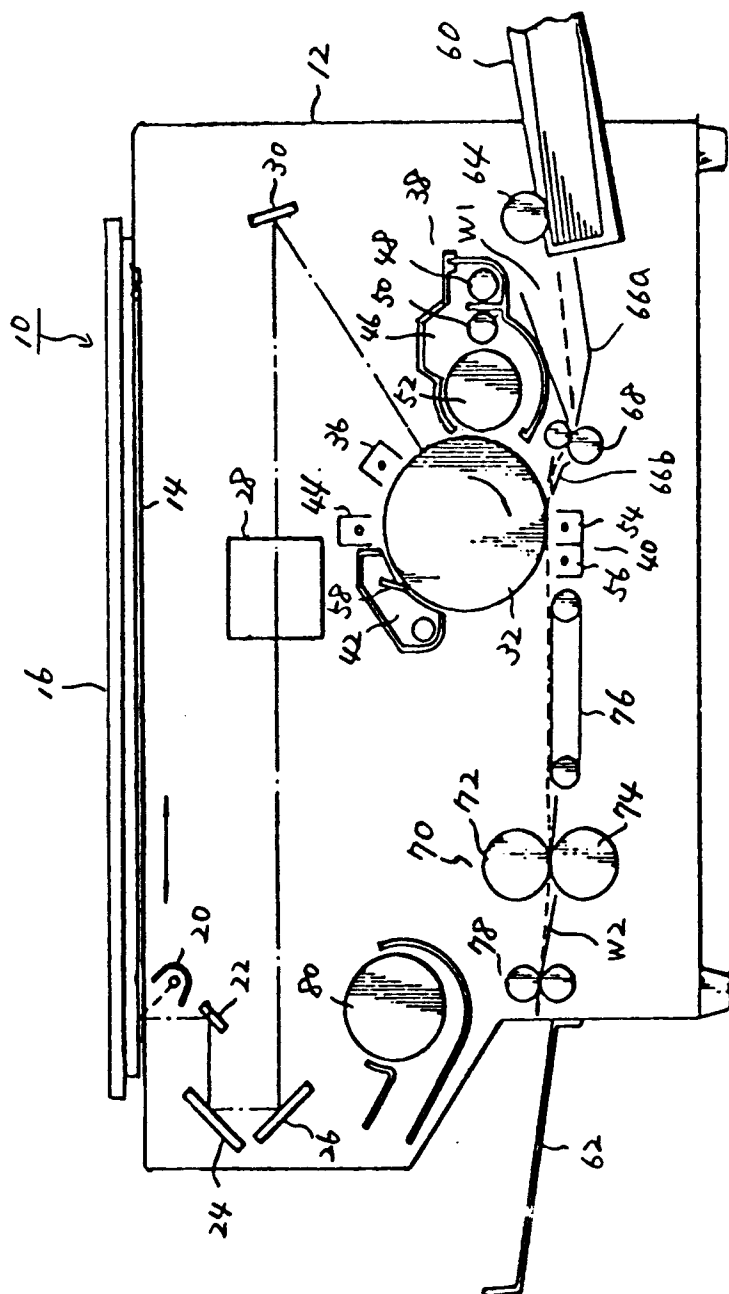
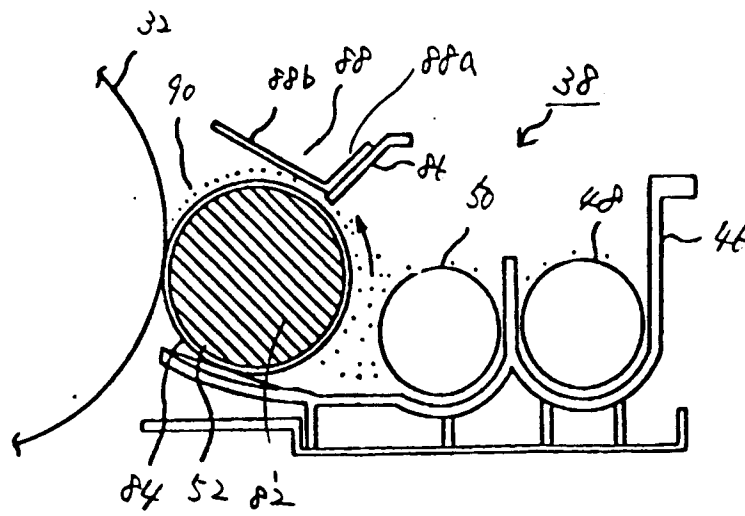
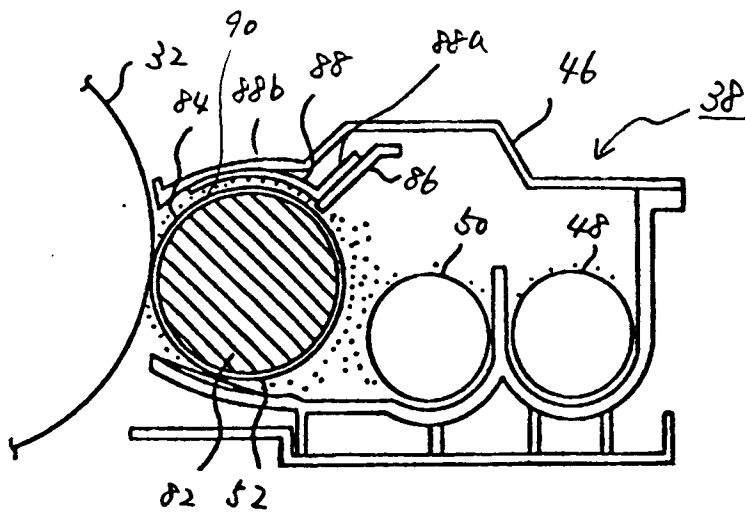


FIG. 1



(a)



(b)

FIG. 2

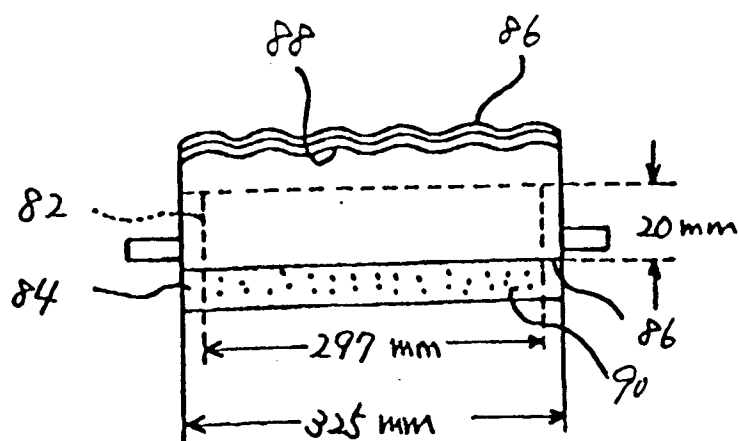


FIG. 3