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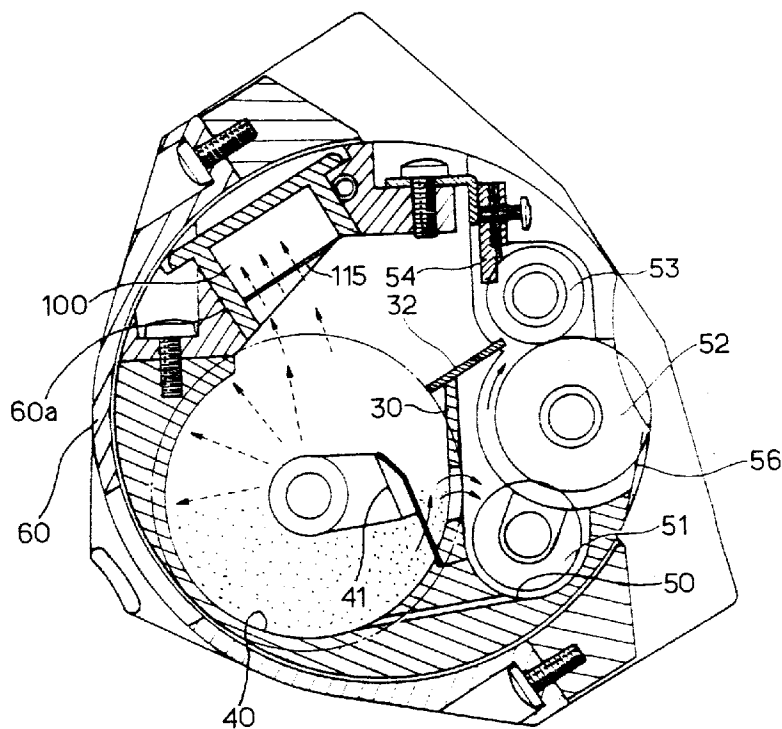
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(54) Developing unit equipped with an air vent for controlling an internal pressure

(57) Disclosed is an air vent for controlling the internal pressure for exhausting the internal air inside of a developing unit, which is located at a predetermined position of the developing unit for preventing the leakage

of the toner caused when the internal pressure generated due to the expansion of the toner received in the inside of the developing unit for forming an electrostatic latent image formed on a photosensitive body is larger than the outer pressure of the developing unit.

FIG 3



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a developing unit and, more particularly to a developing unit having an air vent for controlling internal pressure capable of preventing toner from leaking to the outside of the developing unit. This is achieved by controlling the internal pressure of the developing unit which pressure increases as the volume of the contents inside of the developing unit is made to expand by the agitation of the toner received in the inside of the developing unit.

Description of the Related Art

In an electrophotographic image forming device an electrostatic latent image is formed by radiating light such as a laser beam generated by a laser scanning unit in a dotted image on the surface of a photosensitive body which reacts sensibly to the light. Afterwards, the electrophotographic image forming device forms a visible image on the surface of the photosensitive body by developing toner which is charged with an electrostatic force at the electrostatic latent image, and the toner developed on the photosensitive body is transferred onto and adhered to a recordable medium, and thereafter the printed image is outputted. The image forming device may include: an optical system which converts print data transmitted from a computer, fax, multifunctional machine or a copier connected to the image forming device into a code peculiar to a laser printer, and transmits the laser beam according to this code; a photosensitive body for forming the electrostatic latent image on the surface which is already charged by the transmitted laser beam; a developing unit for supplying the toner for forming the visible image to the electrostatic latent image of the photosensitive body; a transfer unit for transferring the real image formed on the photosensitive body to the recordable medium and adhering the real image onto the recordable medium; and a fixing unit for heat-fixing the toner on the recordable medium by applying heat to the toner which is adhered to the recordable medium.

The structure of the developing unit for supplying the toner to the photosensitive body will now be explained in detail.

At the inner part of a housing which is closed and has a preset area, a separating wall for separating the inner part of the housing into two is located. An opening having a predetermined size is formed at the separating wall.

Of two regions divided by the separating wall, one is a toner receiving region for receiving a bulk amount of toner and the other is a developing region for developing the toner supplied through the opening of the sep-

arating wall from the toner receiving region, at the electrostatic latent image of the photosensitive body.

At the toner receiving region, an agitator for rotating the toner by a certain rpm is located in order to move the toner to the developing region and to prevent the toner from agglomerating into lumps.

In addition, at the developing region, a toner supply roller having a sponge roller shape is formed to contain the toner supplied through the opening of the separating wall. A developing roller is provided at a position where frictional force occurs through contact of the developing roller with the toner supply roller.

A thin layer forming roller is arranged to closely contact the developing roller and is arranged in the developing region in order to ensure that the toner adhered temporarily to the developing roller is evenly applied and has the same thickness. The developing roller on which the toner is caused to be evenly adhered by the thin layer forming roller is located near to the photosensitive body. Accordingly, the toner adhered to the developing roller in the form of a thin layer is transferred to the photosensitive body on which the electrostatic latent image is formed by electrostatic attraction, and the electrostatic latent image of the photosensitive body is developed into the visible image.

The toner for developing the real image on the electrostatic latent image of the photosensitive body has a size of 5 - 16 μm . Assuming that a certain amount of toner is contained in a space which is airtight and is agitated, the volume of the toner is caused to expand to about two times larger than the original volume due to its good mobility. The expansion of volume is caused by the air which enters pores between the particles of the toner.

The expanded toner is contained in the toner receiving region and the developing region in the housing of the developing unit. Due to the expansion pressure of the toner generated when the toner is caused to expand, a high internal pressure is generated in the inside of the developing unit relative to the outside of the developing unit.

A certain difference of the air pressure between the inner part and outer part of the developing unit is generated by the aforesaid internal pressure. Owing to the difference of the air pressure, particles of the toner each having a minute grain size of 5 - 16 μm are caused to leak through minute pores of the developing unit, little by little.

The toner can leak onto or into in a connecting part which has a clearance error when connecting the axis of one roller out of a plurality of rollers supported on the housing of the developing unit with an axis hole of the housing, in a gap between the developing roller and the housing, or in the pore of the housing which occurs when assembling the same.

In order to prevent the toner from being leaked, there is shown an apparatus for reducing the expansion of the toner volume generated in the housing in United

States Patent No. 5,012,289.

The leakage is prevented by locating a leakage prevention ring or a sponge at a part of the developing unit where leakage frequently occurs. However, due to the friction generated between the leakage prevention ring or a sponge and the component part of the developing unit, an overload or malfunction can be generated when operating the developing unit.

SUMMARY OF THE INVENTION

Therefore, it is an object of the present invention to prevent toner received in the inner part of a developing unit from leaking to the outside of the developing unit by minimizing the pressure difference between the inner part and outer part of the developing unit generated by the expansion of volume of the toner received in the inner part of the developing unit.

In the present invention, an air vent for controlling the internal pressure for exhausting the internal air inside of the developing unit is located at a predetermined position of the developing unit for preventing leakage of the toner caused when the internal pressure generated due to the expansion of the toner received in the inside of the developing unit for forming an electrostatic latent image formed on a photosensitive drum, i.e., a photosensitive body is larger than the external pressure of the developing unit.

According to the present invention there is provided developing unit comprising:

an airtight developing unit housing;

a developing roller located within said developing unit housing and which causes toner to adhere to an electrostatic latent image formed on a photosensitive body;

a toner supply roller for supplying said toner to said developing roller;

thin layer forming means for forming a thin layer of toner on said developing roller; and

at least one ventilation means arranged in said developing unit housing operative to relieve a build-up of pressure within the housing by reducing the pressure difference between the inner part and an outer part of said developing unit housing thereby to prevent said toner from leaking to the exterior of the developing unit.

In a first preferred embodiment of the invention, said ventilation means is equipped with a vent hole which communicates between the inner and outer parts of said developing unit housing; and a filter which prevents passage of said toner through said vent hole.

In a variation of this embodiment, said filter is made

of paper.

In an alternative variation of this embodiment said filter is a sponge.

Preferably said filter comprises air transmitting pathways having a size larger than air particles and small than particles of toner.

In another embodiment of the invention said thin layer forming means is a thin layer forming roller, and excess toner adhered to said thin layer forming roller is removed by a scraper.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the present invention, and many of the attendant advantages thereof, will become readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein;

FIG. 1 is a sectional view illustrating a color image forming device including a developing unit according to the present invention;

FIG. 2 is a sectional view illustrating the developing unit of FIG. 1 having an air vent for controlling the internal pressure;

FIG. 3 is a sectional view illustrating a flow path of the toner inside of the developing unit according to the present invention;

FIG. 4 is a sectional view illustrating the air vent for controlling the internal pressure according to the present invention; and

FIG. 5 is a perspective view illustrating a filter of the air vent for controlling the internal pressure of FIG. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The objects, characteristics and advantages of the above-described invention will be more clearly understood through the preferred embodiments referring to the attached drawings.

Referring to FIG. 1, a color image forming device equipped with a developing unit according to the present invention is explained.

At the bottom of the color image forming device, a paper cassette 1 for stacking a plurality of printable media 2 for recording an image is located. Near the paper cassette 1, a feed unit 3 is provided in order for the printable medium 2 of the paper cassette 1 to be supplied one by one (sheet by sheet) to a next process.

After the printable medium 2 supplied from the feed unit 3 is transported to a certain position, it is transported to a transfer roller 4 which is charged with a certain polarity. Afterwards, the printable medium 2 is retained on the transfer roller 4 by electrostatic force.

A photosensitive drum 6 which is the photosensitive body is located close to the transfer roller 4. Adjacent the photosensitive drum 6, a charging roller for charging the photosensitive drum 6 with a certain polarity is located.

At a position which is spaced apart by a certain distance from the photosensitive drum 6 charged with a certain polarity, an optical system 5, such as a laser scanning unit, is arranged for generating a laser beam and radiating the laser beam onto the photosensitive drum 6.

As explained above, the laser beam generated by the optical system 5 is radiated onto the photosensitive drum 6 charged with a certain polarity. The electrostatic latent image which is the same as the print data is formed at the part of the photosensitive drum 6 onto which the laser beam is radiated.

The part of the photosensitive drum 6 where the electrostatic latent image is formed is developed by the toner supplied by a developing unit 7.

The toner is received in a cyan developer 7a, a magenta developer 7b, a yellow developer 7c and a black developer 7d. The four developers 7a to 7d are fixed to and supported by a turret.

After developing the latent image by the toner at the photosensitive drum 6 by the developing unit 7 equipped with the four developers 7a to 7d the toner is scattered and transferred to the printable medium 2 from the photosensitive drum 6 by the difference of the electrostatic attraction with respect to the transfer roller 4.

The toner transferred onto the printable medium 2 passes through the fixing rollers having a temperature of 167° - 200°C and then is fused onto the printable medium.

A reference numeral 10 is a paper stacker (which is not illustrated) on which a plurality of printable media are outputted and stacked.

The developing unit having the air vent for controlling the internal pressure according to the color image forming device having the above structure is explained with reference to FIG. 2.

The housing of the developing unit has a certain cylindrical airtight region and is divided into two by a separating wall 30 which includes an opening with a certain area.

Of the two regions, one is a toner receiving region 40 in which a bulk amount of toner is stored. In the toner receiving region 40, an agitator 41 is located for agitating the toner in order to supply the toner to the other region.

The other region is a developing region 50 in which the toner supplied from the toner receiving region 40 is developed at the electrostatic latent image of the photosensitive drum 6. In the developing region 50, the charging amount of toner per unit of mass is optically set by frictionally rubbing the toner, and a toner supply roller 51, a developing roller 52, a thin layer forming roller 53 and a scraper 54 are arranged so that the charged toner can be supplied to the electrostatic latent image

of the photosensitive drum.

The component parts arranged in the developing region will now be explained in detail. The toner supply roller 51 which has the form of a sponge roller is provided so that the toner supplied to the developing region 50 through the opening of the separating wall 30 by the agitator 41 from the toner receiving region 40 can be supplied initially.

In addition, the developing roller 52 is arranged to contact to the toner supply roller 51 for subsequently supplying the toner to the photosensitive drum 6. As a result, the toner supply roller 51 is caused to rub against the developing roller 52 and the toner is frictionally charged with a certain voltage and thereby adhered to the developing roller 52 temporarily.

Since the toner which is temporarily adhered to the developing roller 53 has a very uneven thickness, in the case that the toner is moved in this state directly to the photosensitive drum 6, the developing density becomes uneven and the print quality is degraded. Accordingly, in order to form a thin layer of toner adhered to the developing roller 52 which has an even thickness, the thin layer forming roller 53 is provided closely adjacent the developing roller 52.

To remove the toner adhered to the thin layer forming roller 53 during evenly forming the toner layer of the developing roller 52, scraper or doctor blade 54 is located at the thin layer forming roller 53.

As the volume of the toner in receiving region 40 expands on agitation by the agitator 41 the internal pressure in the toner receiving region 40 and the developing region 50 (which are the inner regions of the housing 60) becomes higher than the pressure of the outside of the housing 60.

In order to prevent toner which has a minute grain size from leaking to the outside of the housing 60 because of the higher internal pressure and from contaminating the developing unit, an air vent 100 for controlling the internal pressure is provided in the developing unit.

The air vent 100 for controlling the internal pressure of the developing unit can be located in the toner receiving region 40 or the developing region 50.

Referring to FIGs. 4 and 5, there is shown an air vent for controlling the internal pressure of the developing unit.

In order to minimize the difference between the internal pressure of the housing 60 of the developing unit and the outer pressure outside of the developing unit, at least one air vent 100 is provided.

For locating the air vent 100 for controlling the internal pressure at the developing unit, at least one through hole 60a is formed in the housing 60 of the developing unit, by means of which the inner part and outer part of the housing 60 communicates with the outer part of the housing 60.

The air vent 100 for controlling the internal pressure is equipped with the filter 110 which has a shape of pipe. The air vent 100 and filter 110 allow air to be exhausted

from the inside of the developing unit while preventing toner from leaking to the outside. The air vent is located in hole 60a.

As the filter 110, various kinds of filters can be used. Here, as an embodiment, a filter paper is used. It is also possible to use a sponge having minute vent holes.

An example of a suitable filter paper is one manufactured by Schleider & Schuell. In this filter paper the vent hole 115 has construction comprising meshes through which the toner having relatively larger particles cannot pass and the air having relatively smaller particles can pass.

The operation of the developing unit having the air vent for controlling the internal pressure having the above structure will now be explained with reference to FIG. 3.

In the drawing, the transporting path of the toner in the developing unit equipped with the air vent 100 for controlling the internal pressure according to the present invention is illustrated. In the drawing, the dotted lines indicate paths for the toner and air which are mixed, and the solid lines are paths for the toner only.

First, the toner received in the toner receiving region 40 is agitated by the rotation of the agitator 41, and thereby its volume becomes twice the original volume. One part of the toner which is doubled in volume is transported to the developing region 50 through the opening formed at the separating wall 30, and it becomes adhered to the electrostatic latent image of the photosensitive drum, thereby being developed.

At this time, the other part of the toner is agitated by the agitator 41 and mixed with air, and it is not supplied to the developing region 50. As described, as significant amount of the toner which is mixed with the air is transported towards the air vent 100 which controls the internal pressure due to the internal pressure of the developing region 50.

In other words, since the filter paper having the vent hole 115 for passing the air particles is attached to the entrance of the air vent 100 for controlling the internal pressure, the toner does not escape and only the air particles escape, thereby forming a low pressure region. Accordingly, the toner mixed with the air is transported towards the air vent 100.

As a result, the toner mixed with the air is made to flow into the air vent 100 for controlling the internal pressure from the agitator 41, i.e., center part of the developing unit by the difference of the air pressure. Out of the toner and air which flow into the air vent 100, only the air is exhausted to the outside of the developing unit, and thereby the internal pressure of the developing unit decreases.

As described above, as the internal pressure of the developing unit gradually decreases, the difference between the pressure inside of the housing 60 of the developing unit and the pressure outside of the housing 60 also decreases.

In addition, as the pressure difference decreases,

the leakage of the toner which is proportional to the pressure difference also decreases. As a result, the environmental pollution, the pollution of surrounding devices located near the developing unit, and the shortening of the life of the image forming device can be prevented.

While there have been illustrated and described what are considered to be preferred embodiments of the present invention, it will be understood by those skilled in the art that various changes and modifications may be made, and equivalents may be substituted for elements thereof without departing from the true scope of the present invention. In addition, many modifications may be made to adapt a particular situation to the teaching of the present invention without departing from the central scope thereof. Therefore, it is intended that the present invention not be limited to the particular embodiment disclosed as the best mode contemplated for carrying out the present invention, but that the present invention includes all embodiments falling within the scope of the appended claims.

Claims

1. A developing unit comprising:

an airtight developing unit housing;

a developing roller located within said developing unit housing and which causes toner to adhere to an electrostatic latent image formed on a photosensitive body;

a toner supply roller for supplying said toner to said developing roller;

thin layer forming means for forming a thin layer of toner on said developing roller; and at least one ventilation means arranged in said developing unit housing operative to relieve a build-up of pressure within the housing by reducing the pressure difference between the inner part and an outer part of said developing unit housing thereby to prevent said toner from leaking to the exterior of the developing unit

2. A developing unit as claimed in claim 1, wherein said ventilation means is equipped with a vent hole which communicates between the inner and outer parts of said developing unit housing; and a filter which prevents passage of said toner through said vent hole.

3. A developing unit as claimed in claim 2, wherein said filter is made of paper.

4. A developing unit as claimed in claim 2, wherein said filter is a sponge.

5. A developing unit as claimed in any of claims 2, 3 or 4 wherein, said filter, comprises air transmitting pathways having a size larger than air particles and smaller than particles of toner.

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6. A developing unit as claimed in any preceding claim wherein said thin layer forming means is a thin layer forming roller, and excess toner adhered to said thin layer forming roller is removed by a scraper.

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FIG 1

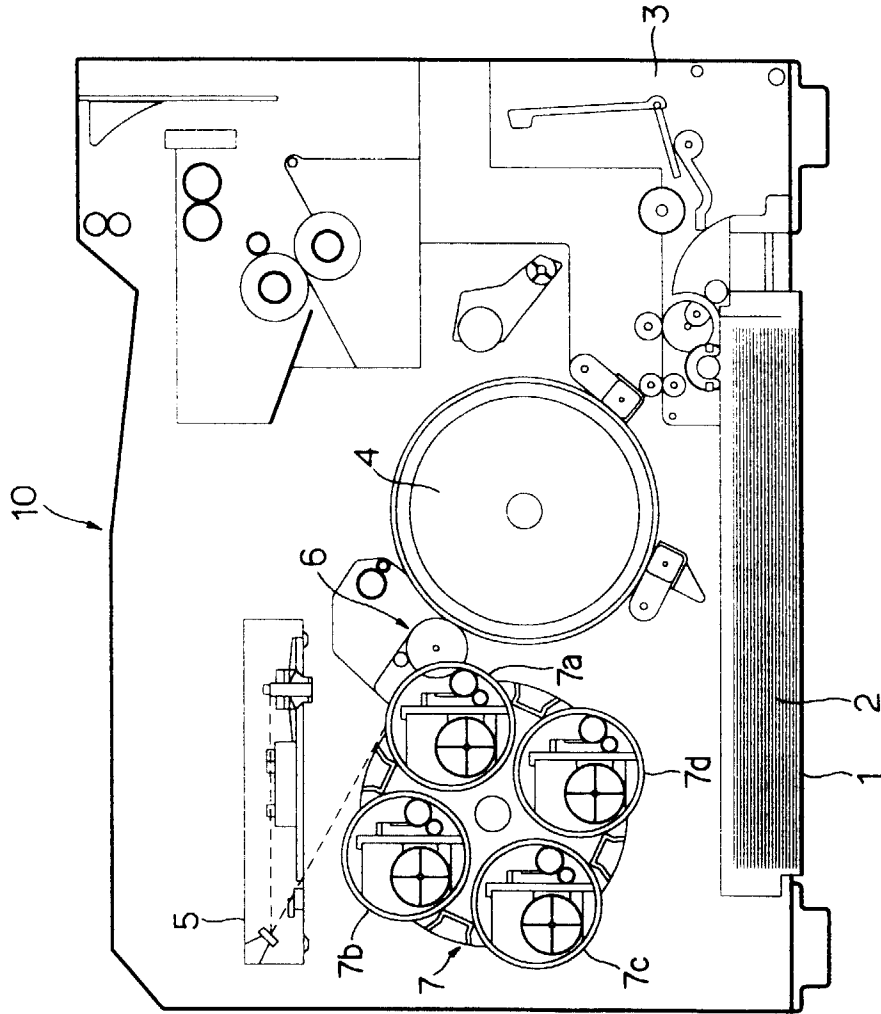


FIG 2

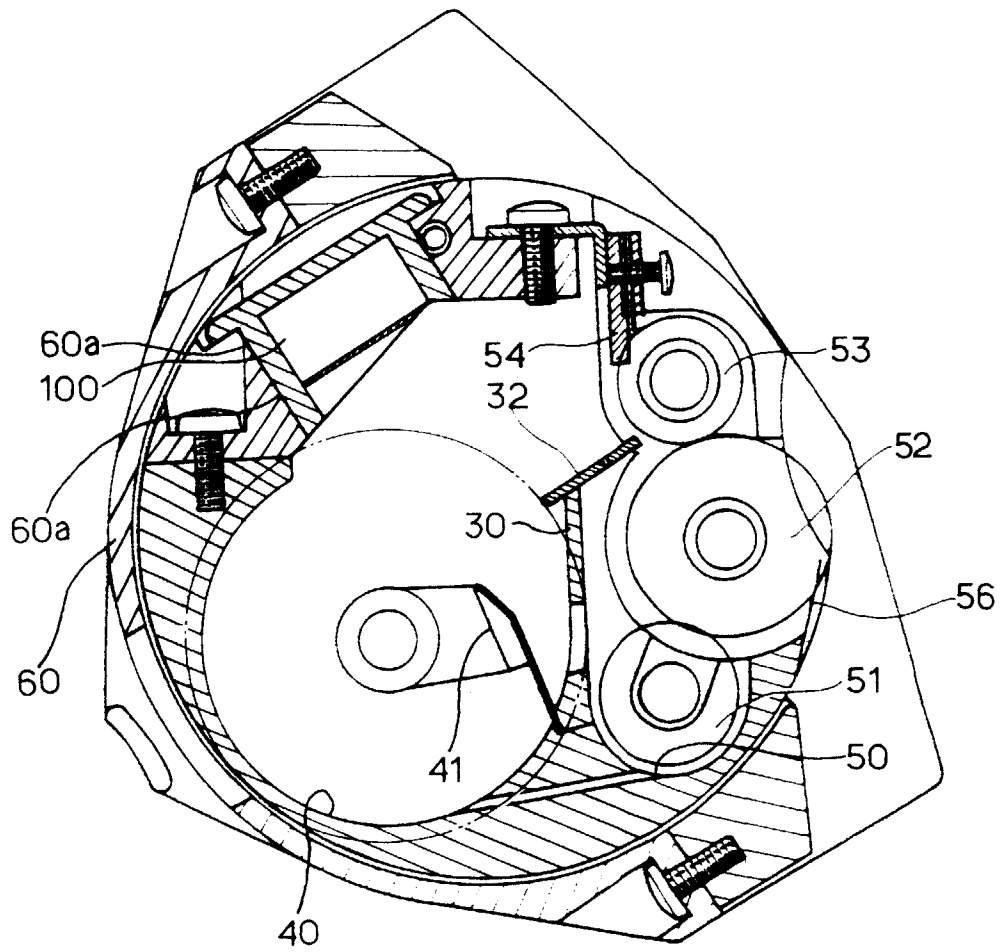


FIG 3

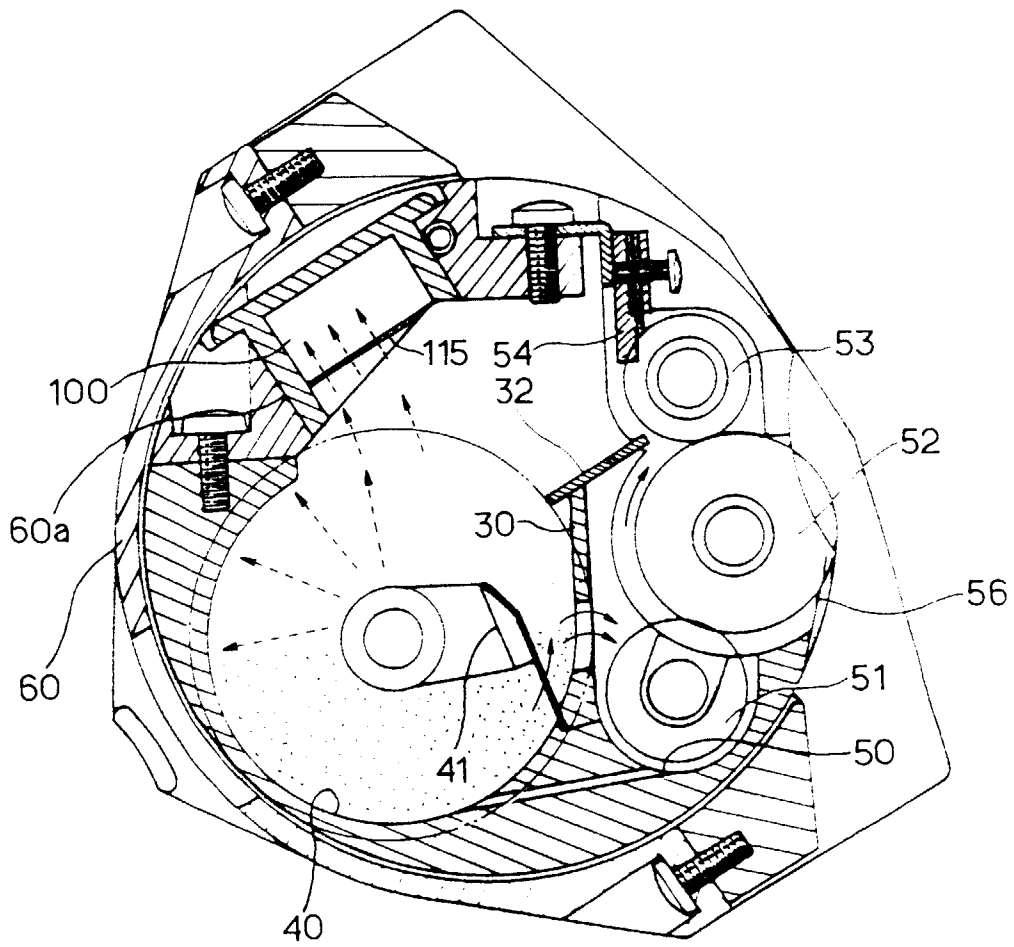


FIG 4

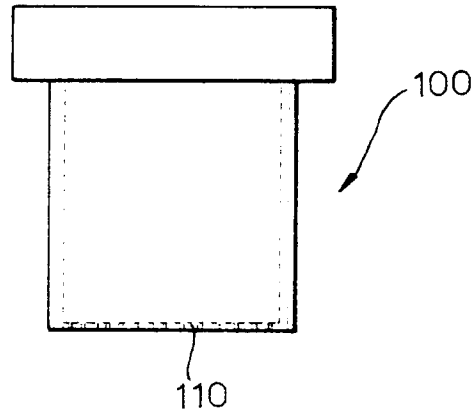
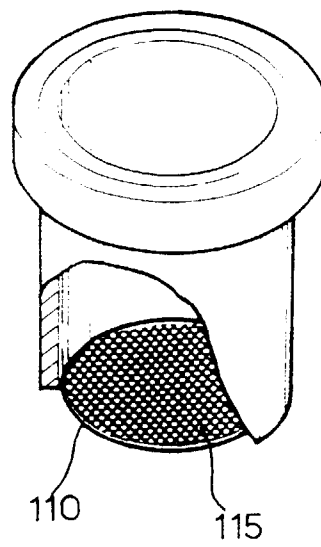


FIG 5





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 30 5958

| 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) |
| P,X | EP 0 807 865 A (CANON KK) 19 November 1997 * abstract; claims; figures * | 1,2 | G03G15/08 |
| P,X | PATENT ABSTRACTS OF JAPAN vol. 098, no. 001, 30 January 1998 & JP 09 230686 A (RICOH CO LTD), 5 September 1997 * abstract * | 1,2 | |
| X | EP 0 578 190 A (KONISHIROKU PHOTO IND) 12 January 1994 * abstract; figures 1,2 * | 1,2 | |
| X | US 4 963 930 A (YOSHIMARU AKITO ET AL) 16 October 1990 * abstract; figure 1 * | 1,2 | |
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| A | US 4 377 334 A (NISHIKAWA MASAJI) 22 March 1983 * figures 2-5 * | 1,2 | |
| A | US 5 592 266 A (PARK DONG-HOON ET AL) 7 January 1997 * figure 3 * | 1,6 | G03G |
| The present search report has been drawn up for all claims | | | |
| Place of search BERLIN | | Date of completion of the search 23 October 1998 | Examiner Hoppe, H |
| CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document | | T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document | |

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