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(54) IMAGE FORMING APPARATUS AND PROCESS-CARTRIDGE

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(57) **ABSTRACT**

An image forming apparatus has an electrostatic latent image bearing member, charging means for uniformly charging a surface of the electrostatic latent image bearing member, developing means for visualizing an electrostatic latent image formed on the electrostatic latent image bearing member with a developer, transferring means for transferring a developer image formed on the electrostatic latent image bearing member to a transferring material, and cleaning means for cleaning the surface of the electrostatic latent image bearing member by bringing a cleaning blade consisting of an elastic blade into contact with the surface of the electrostatic latent image bearing member. The cleaning blade has a portion to be brought into contact with the surface of the electrostatic latent image bearing member and at least resin films on surfaces at both ends outside a developing area in a longitudinal direction.

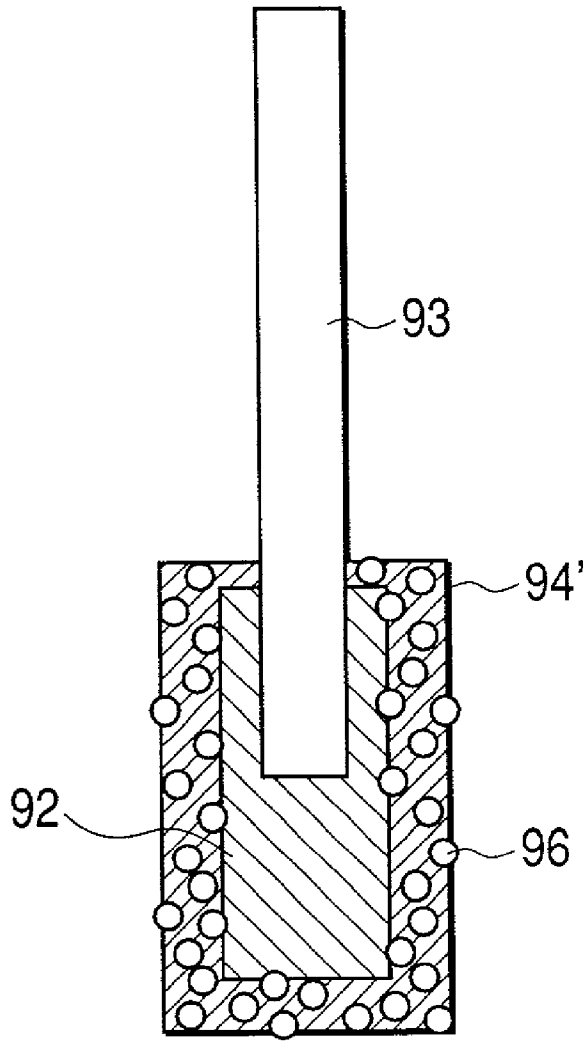

FIG. 1

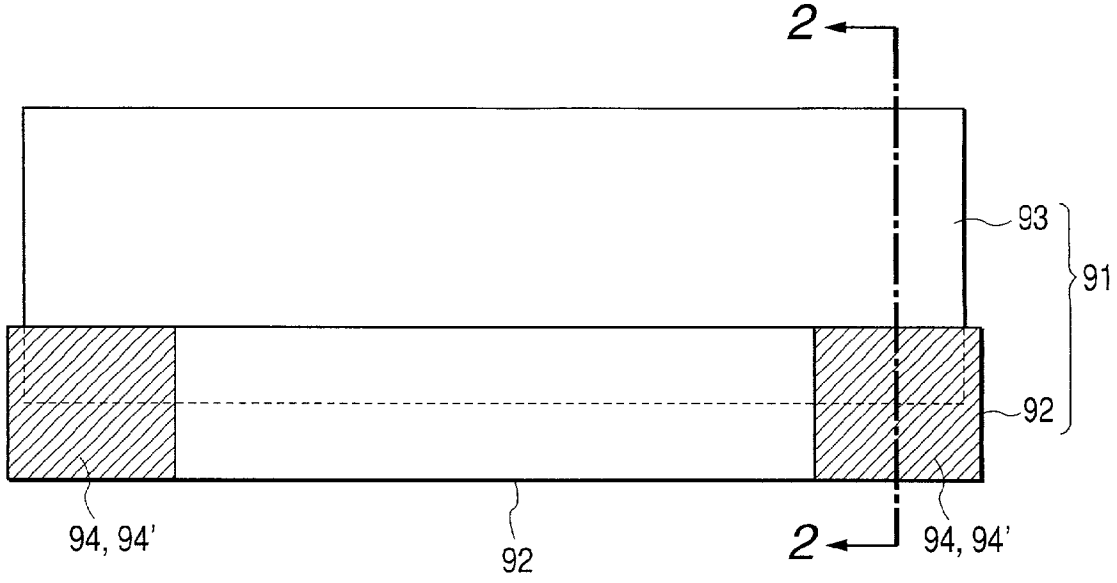

FIG. 2

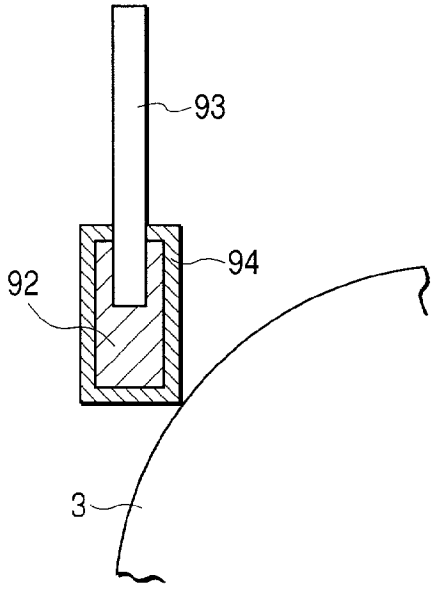

FIG. 3

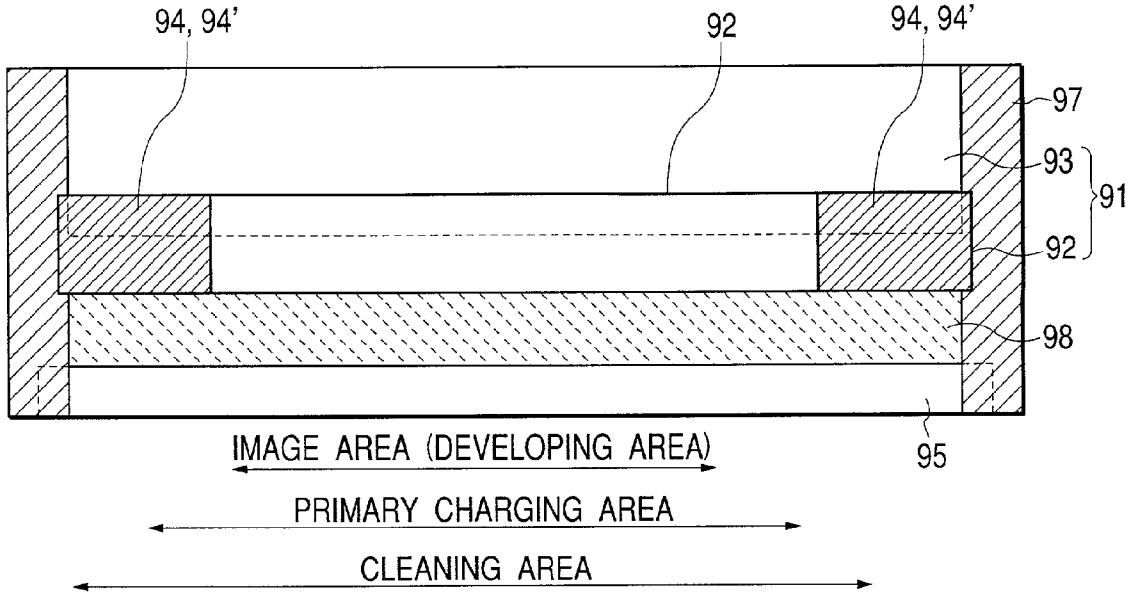
94, 94'
92
94, 94'
97
93
91
92
98
95
IMAGE AREA (DEVELOPING AREA)
PRIMARY CHARGING AREA
CLEANING AREA

FIG. 4

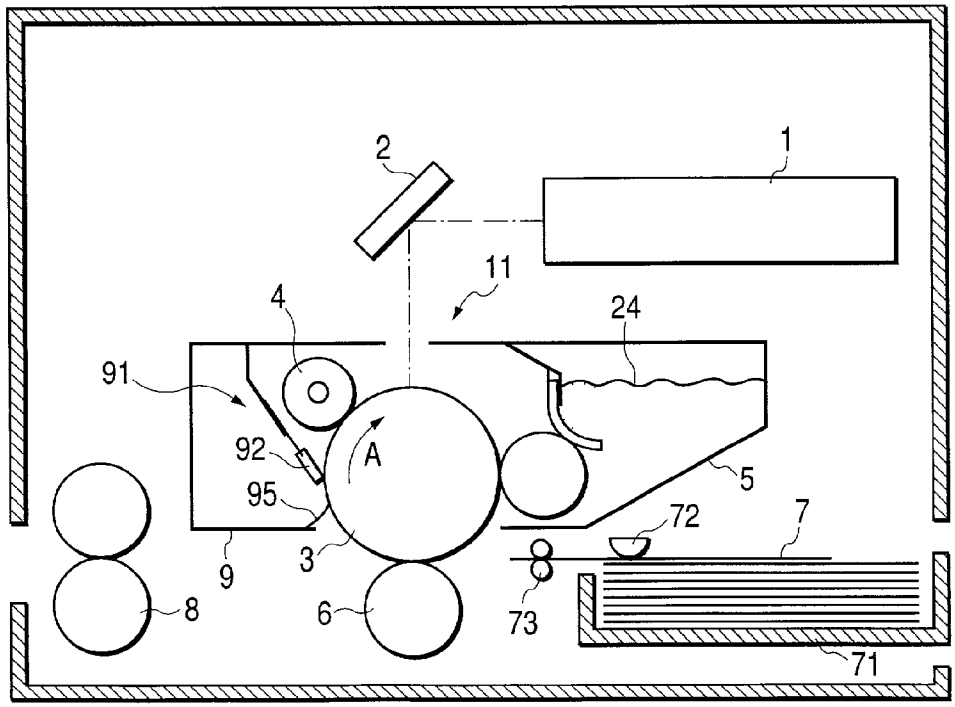
2
1
11
4
24
91
92
A
95
5
72
7
3
9
8
6
73
71

FIG. 5

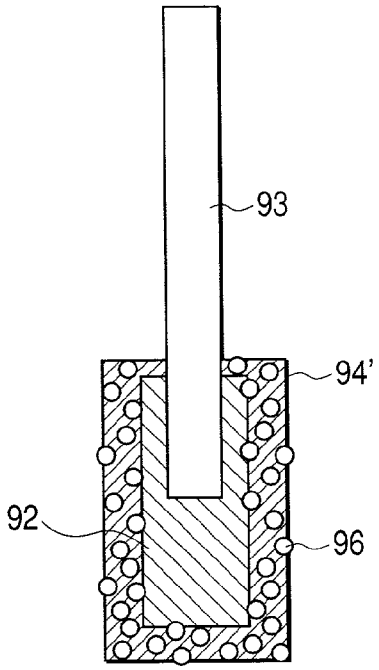

FIG. 6

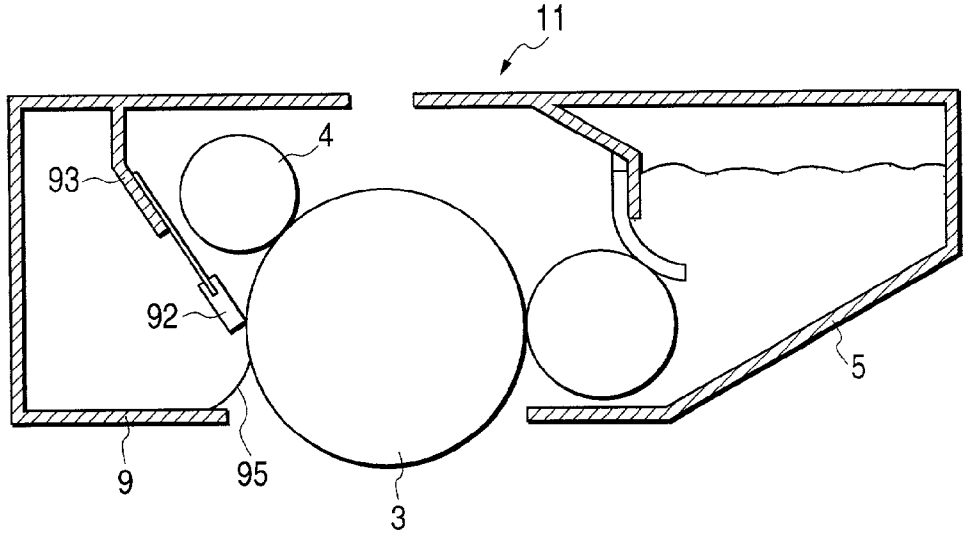

FIG. 7

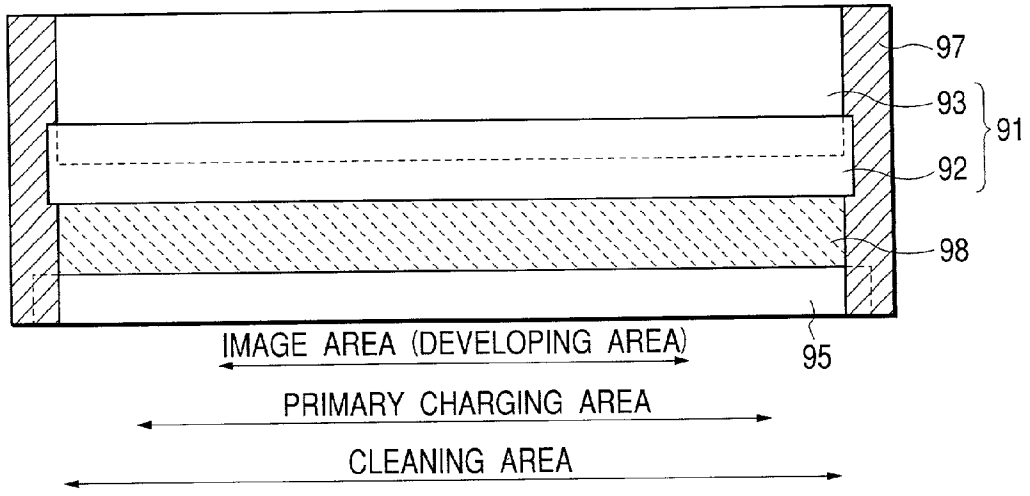
97
93
91
92
98
95
IMAGE AREA (DEVELOPING AREA)
PRIMARY CHARGING AREA
CLEANING AREA

FIG. 8

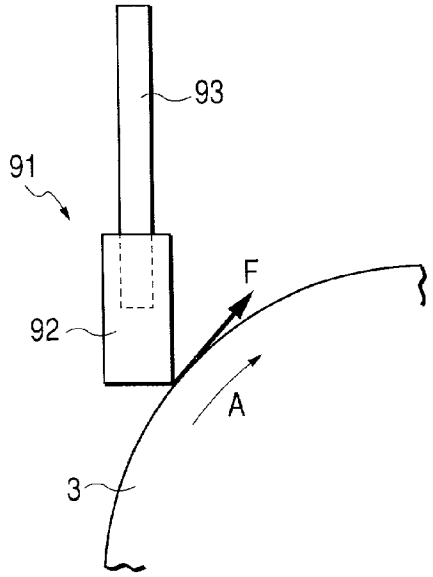
93
91
F
92
A
3

IMAGE FORMING APPARATUS AND PROCESS-CARTRIDGE

BACKGROUND OF THE INVENTION

[0001] Field of the Invention and Related Background Arts

[0002] The present invention relates to an image forming apparatus which has at least an electrostatic latent image bearing member and a cleaning blade for cleaning a surface of the above described electrostatic latent image bearing member as well as a process-cartridge detachably attachable to the above described image forming apparatus.

[0003] An image forming apparatus such as a printer forms an electrostatic latent image by exposing to light a photosensitive drum which is a uniformly charged electrostatic latent image bearing member, forms a toner image by visualizing the electrostatic latent image with a toner and records an image by transferring the above described toner image to a recording medium. The toner remaining on the surface of the photosensitive drum after the transferring is removed with a cleaning apparatus.

[0004] **FIG. 7** and **FIG. 8** are diagrams descriptive of the cleaning apparatus. The cleaning apparatus consists of a cleaning blade **91** having a blade **92** which functions to scrape the toner remaining after the transferring from the photosensitive drum and is supported by a supporting member **93**, and a scooping sheet **95** which collects scraped toner remaining after the transferring. Furthermore, elastic members **97** made of a material such as foam polyurethane are disposed at both ends of the cleaning blade over a cleaner container so as to limitlessly narrow gaps between the blade and the elastic members, thereby preventing the scraped toner from leaking from the cleaner container. As a cleaner, the cleaning apparatus can recover the toner from only a range of an opening which is enclosed by the blade **92**, the scooping sheet **95** and blade end seals as indicated by a meshed portion **98** in a schematic longitudinal view of a cleaner section as seen from the electrostatic latent image bearing member (photosensitive drum) shown in **FIG. 7**. Though the toner is developed on the photosensitive member usually within an image area, a small amount of scattered toner may adhere to the photosensitive drum outside the developing area. In order to allow the scattered toner to adhere in an amount as small as possible, the cleaning apparatus is constituted to reserve primary charging areas as large as possible at both the ends outside an image area so that both the ends hardly attract the toner. Even when the cleaning apparatus is constituted as described above, it is difficult to completely prevent the toner from adhering to both the ends. It is therefore necessary to constitute the cleaning blade **91** and the scooping sheet **95** so as to have sufficient lengths in a longitudinal direction so as to clean a sufficient range including areas outside the image area.

[0005] Though urethane rubber is frequently used as a material of the blade **92** from a viewpoint of durability, a portion which is to be brought into contact with the electrostatic latent image bearing member is coated with fine particles of silicone resin or particles of fluorine to obtain a lubricating property since the urethane rubber has a high adhesive property and a low lubricating property.

[0006] Since the above described cleaning blade **91** is in contact with the electrostatic latent image bearing member **3** in a direction counter to its rotating direction A, however, a force is exerted in a direction indicated by an arrow F in **FIG. 8** and when a frictional force is excessive between the electrostatic latent image bearing member and the blade **92**, the edge of the cleaning blade **92** may be turned over in the direction indicated by the arrow F, resulting in a turnover of the blade **92**. The blade **92** which obtains the lubricating property owing to a lubricant applied over the edge of the blade **92** as described above is likely to have a turnover in an environment at a high temperature and a high humidity when the coated lubricant comes off.

[0007] Since the lubricant is only adhering to a surface of the blade **92** mainly physically and electrostatically, the lubricant has a relatively weak adhesive force and may come off due to sliding friction with the photosensitive drum and vibrations caused by sliding after a long time of use. In such a case, the toner remaining after the transferring and fogging toner (toner inverted in a polarity and developed in a white area which is originally not to be developed) are supplied to the image area, whereby the toners and an external additive contained in the toners function as a lubricant and provides an effect to prevent a turnover of the blade **92** from occurring. Outside the image area, however, powder materials such as the toner remaining after the transferring and the fogging toner which can function as the lubricant are scarcely supplied, so that the blade **92** is apt to turn over when the initially coated lubricant comes off.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide an image forming apparatus and a process-cartridge having a cleaning apparatus capable of carrying out cleaning favorably without any turnover of a cleaning blade even for long use.

[0009] An object of the present invention is to provide an image forming apparatus comprising:

[0010] an electrostatic latent image bearing member;

[0011] charging means for uniformly charging a surface of the above described electrostatic latent image bearing member;

[0012] developing means for visualizing an electrostatic latent image formed on the above described electrostatic latent image bearing member with a developer;

[0013] transferring means for transferring a developer image formed on the above described electrostatic latent image bearing member to a transferring material; and

[0014] cleaning means for cleaning a surface of the above described electrostatic latent image bearing member by bringing a cleaning blade consisting of an elastic blade into contact with the surface of the electrostatic latent image bearing member,

[0015] wherein the above described cleaning blade has a portion which is to be brought into contact with the surface of the above described electrostatic latent image bearing member and at least resin films on surfaces of both ends outside a developing area in a longitudinal direction.

[0016] Furthermore, an object of the present invention is to provide a process-cartridge comprising at least;

[0017] an electrostatic latent image bearing member and cleaning means for cleaning a surface of the above described electrostatic latent image bearing member,

[0018] wherein at least the above described electrostatic latent image bearing member and the cleaning means for cleaning the surface of the above described electrostatic latent image bearing member are integrated with each other and detachable from a main body of an image forming apparatus, and

[0019] a cleaning blade has a portion which is to be brought into contact with the surface of the above described electrostatic latent image bearing member and at least resin films on surfaces at both ends outside a developing area in a longitudinal direction.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] **FIG. 1** is a schematic sectional view descriptive of a cleaning blade according to a first embodiment of the present invention.

[0021] **FIG. 2** is a sectional view taken along a **2-2** line of the cleaning blade shown in **FIG. 1**.

[0022] **FIG. 3** is a diagram descriptive of a relation among a length of resin films **94** of a blade **92** in a longitudinal direction of a blade **92**, a developing area, a primary charging area and a cleaning area.

[0023] **FIG. 4** is a schematic sectional view descriptive of a main body of an image forming apparatus according to the first embodiment of the present invention.

[0024] **FIG. 5** is a schematic sectional view of a cleaning blade according to a second embodiment.

[0025] **FIG. 6** is a schematic sectional view descriptive of a process-cartridge according to a third embodiment.

[0026] **FIG. 7** is a diagram descriptive of a cleaning step.

[0027] **FIG. 8** is a diagram descriptive of a turnover phenomenon of a cleaning blade.

DETAILED DESCRIPTION OF THE INVENTION

[0028] Now, description will be made of embodiments of the present invention with reference to the accompanying drawings.

[0029] First Embodiment

[0030] **FIG. 4** is a schematic constitutional diagram of an image forming apparatus used in a first embodiment, in which a laser beam modulated in accordance with an image signal is scan output from a scanner unit **1** which comprises a laser, a polygonal mirror and a lens system, reflected by a reflection mirror **2** and projected to a photosensitive drum **3** which is an electrostatic latent image bearing member to form an electrostatic latent image. The photosensitive drum **3** is charged uniformly by a primary charger **4** consisting of a charging roller, and an electrostatic latent image is formed on a surface of the photosensitive drum **3** by irradiation with the laser beam. This electrostatic latent image is visualized as a toner image by a toner **24** contained in a developing apparatus **5**. On the other hand, a recording material **7** (for example, plain paper) contained in a sheet feeding cassette **71** is fed by a sheet feeding roller **72** to a registration roller **73** in synchronization with formation of the electrostatic latent image on the photosensitive drum **3**. The recording material **7** is conveyed by the registration roller **73** to a transferring charger **6** in synchronization with a leading end of the electrostatic latent image formed on the photosensitive drum **3** and the above described toner image is transferred by the transferring charger **6** to the above described recording material **7**. The recording material **7** to which the toner image has been transferred is subjected to permanent fixing of the toner image by a heat and pressure fixing apparatus **8** and then discharged outside the image forming apparatus. The toner which remains on the photosensitive drum **3** is removed with a cleaning apparatus **9** using a cleaning blade **91** which has a blade **92** having elasticity. The cleaning apparatus **9** is disposed close to the photosensitive drum **3** which rotates in a direction indicated by an arrow A and an edge at an end of the blade **92** is in contact with the surface of the photosensitive drum **3** in a counter direction. The toner which remains after the transferring reaches a position of the blade **92** in a condition adhering to the photosensitive drum **3**, and is scraped off by the blade **92**, further guided by a scooping sheet **95** and accommodated into a cleaning container.

[0031] The present invention will be described below in detail based on **FIG. 1**.

[0032] **FIG. 1** shows a front view of a cleaning blade **91** on which resin films are disposed, and **FIG. 2** is a sectional view of the cleaning blade taken along a **2-2** line in **FIG. 1**. The cleaning blade **91** has a blade **92** made of urethane-based rubber which is bonded and fixed to a supporting plate metal **93**. Resin films **94** are formed on surfaces at both ends outside a developing area in a longitudinal direction of the blade **92** and disposed so as to be brought into contact with the photosensitive drum **3**.

[0033] Though the resin film **94** may be selected appropriately from among those which are generally used as coating materials, it is preferable to use a material which has a small coefficient of friction with the photosensitive drum **3** since the resin film **94** is always in frictional contact with the photosensitive drum **3**. From such a viewpoint, mentionable as materials for the resin film **94** are polyamide resin, polyimide resin, silicone resin, polyacetal resin and fluorine-containing resin. Taking into consideration elasticity, permanent distortion and a durability of the blade **92** itself and an adhesive property to the blade **92**, it is preferable that the resin film **94** has a thickness of 0.1 to 100 μm, more preferably of 1 to 20 μm. Mentionable as a method to form the resin film **94** is a method to bond a resin film to a blade surface, or a method to apply solvent-soluble resin using a brush, a roller or the like or by dipping.

[0034] A durability test was effected while passing sheets in an environment at a high temperature and a high humidity (30° C./80% Rh) using a cleaning blade **91** having a blade **92** which had a polyamide resin film 5 μm thick coated by dipping on surfaces at both ends outside a developing area in a longitudinal direction of the blade **92** made of urethane-based rubber and inside a primary charging area. A cleaning blade **91** which had a blade not coated with resin films was

used for comparison. As an initial lubricant for these blades, fluorocarbon was applied over entire portions which were to be brought into contact with the photosensitive drum **3**. As a result of the durability test, when the comparative blade was used, the initially applied lubricant was consumed when 15,000 sheets were passed and a turnover occurred of the blade immediately thereafter. When the blade according to the first embodiment which had the coats at the ends was used, in contrast, cleaning was carried out favorably even after 20,000 sheets were passed though the initially applied lubricant was consumed when 13,000 sheets were passed.

[**0035**] By forming resin films on the surfaces at both the ends including the portion which was to be brought into contact with the electrostatic latent image bearing member and outside the developing area in the longitudinal direction as described above, it was possible to maintain a sufficient lubricating property and prevent the turnover of the blade from occurring even when the initially applied lubricant was peeled off.

[**0036**] Second Embodiment

[**0037**] A second embodiment is characterized in that lubricating fine particles are contained in the resin films formed at both the ends of the blade of the cleaning blade described in the first embodiment.

[**0038**] When the fine lubricating particles are contained in the resin films, the fine lubricating particles exist on the portion of the blade which is to be brought into contact with the electrostatic latent image bearing member even after the initially applied lubricant is peeled off, thereby making it possible to maintain a lubricating property more effectively and prevent the turnover of the blade from occurring.

[**0039**] Description will be made of the cleaning blade according to the present invention based on **FIG. 5**. A fundamental constitution remains unchanged from that described in the first embodiment and will not be described in particular. Lubricating fine particles **96** are contained in resin films **94'** which are formed on surfaces at both ends outside a developing area in a longitudinal direction of a blade of a cleaning blade and inside the primary charging area.

[**0040**] Usable as the lubricating fine particles are inorganic substances and/or organic substances which are generally known as solid lubricants. Mentionable as the inorganic substances are talc, calcium carbonate, molybdenum bisulfide, silicon dioxide and graphite. Mentionable as the organic substances are fluorine-containing resin, polyamide resin, silicone resin and polyacetal resin. Fluorine-based compounds which have low frictional resistance in particular are preferable.

[**0041**] Suited as powder of a fluorine-based compound is graphite fluoride, polyvinylidene fluoride resin, tetrafluoroethylene resin, tetrafluoroethylene-hexafluoropropylene copolymer resin, tetrafluoroethylene-perfluoroalkoxyethylene copolymer resin, trifluoroethylene chloride resin or tetrafluoroethylene-ethylene copolymer resin.

[**0042**] As for a particle diameter of the lubricating fine particles, it is preferable that the particles have an average particle diameter of 20 μm or smaller so as not to lower a cleaning property of a toner, more preferably of 12 μm or smaller.

[**0043**] 50 parts by weight of fluorocarbon having an average particle diameter of 1 μm was dispersed uniformly in a 100 parts by weight of polyamide resin, the dispersion was applied over surfaces at both ends outside a developing area in a longitudinal direction of a blade and durability tests were effected while passing sheets in an environment at a high temperature and a high humidity (30° C./80% Rh) as in the first embodiment. Fluorocarbon was applied as an initial lubricant over entire portions which were to be brought into contact with a photosensitive drum. As a result of the durability test, when a comparative blade having no resin layer at both ends was used, the initially applied lubricant was consumed when 15,000 sheets were passed and a turnover occurred in the blade immediately thereafter. When the blade according to the second embodiment which had the coated ends in the longitudinal direction was used, in contrast, cleaning was carried out favorably even after 20,000 sheets were passed though the initially applied lubricant was consumed when 14,000 sheets were passed.

[**0044**] By forming the resin films containing the lubricating fine particles on the surfaces of the blade of the cleaning blade including the portion to be brought into contact with the surface of the electrostatic latent image bearing member and outside the developing area in the longitudinal direction as described above, it was possible to maintain a sufficient lubricating property and prevent the turnover of the blade from occurring even when the initially applied lubricant was peeled off.

[**0045**] Third Embodiment

[**0046**] Then, a third embodiment of the present invention will be described based on **FIG. 6**.

[**0047**] Description will be made of a schematic constitution of a process-cartridge. A process-cartridge **11** is constituted as a unit consisting of the above described photosensitive drum **3**, charging roller **4**, developing apparatus **5**, cleaning apparatus **9** which are integrated with one another. These component members are assembled in a cartridge in a predetermined relative positional relation and the cartridge is mounted at a predetermined location to a main body of an image forming apparatus so as to be detachable from the main body of the image forming apparatus.

[**0048**] When the image forming apparatus is used for a long time, various kinds of component members such as the photosensitive drum, the charger, the developing apparatus, the cleaning apparatus and the like are consumed, thereby lowering a print quality, but the image forming apparatus can be constituted as a maintenance-free cartridge type which allows a user to replace a process cartridge with a new one in such a case.

[**0049**] Though the cartridge type image forming apparatus allows the user to easily detach and attach cartridges when a recording sheet is jamming and detaching and attaching operations may accelerate the peeling off of the lubricant initially applied over the blade of the cleaning blade, use of the cleaning blade according to the present invention makes it possible to maintain a sufficient lubricating property even when the initially applied lubricant comes off, thereby carrying out cleaning favorably until a service life of a cartridge expires.

[**0050**] A first invention according to the present invention provides an image forming apparatus which comprises an electrostatic latent image bearing member, charging means for uniformly charging a surface of the above described electrostatic latent image bearing member, developing means for visualizing an electrostatic latent image formed on the above described electrostatic latent image bearing member with a developer, transferring means for transfer-

ring a developer image formed on the above described electrostatic latent image bearing member to a transferring material and cleaning means for cleaning the surface of the electrostatic latent image bearing member by bringing a cleaning blade consisting of an elastic blade into contact with the surface of the above described electrostatic latent image bearing member, and uses a cleaning blade characterized by having resin films formed on surfaces at both ends including a portion of the above described cleaning blade to be brought into contact with the surface of the above described electrostatic latent image bearing member and outside a developing area in a longitudinal direction, thereby being capable of maintaining a sufficient lubricating property and preventing a turnover of a blade from occurring even when an initially applied lubricant comes off after long use.

[0051] Furthermore, a second invention according to the present invention provides an image forming apparatus which uses a cleaning blade characterized on that resin films formed on the surface of the above described cleaning blade contain lubricating fine particles, whereby the lubricating fine particles which exist on a portion of the blade to be brought into contact can maintain a lubricating property and prevent the turnover of the blade from occurring even after an initially applied lubricant comes off for long use.

What is claimed is:

1. An image forming apparatus, comprising:

an electrostatic latent image bearing member;

charging means for uniformly charging a surface of said electrostatic latent image bearing member;

developing means for visualizing an electrostatic latent image formed on said electrostatic latent image bearing member with a developer;

transferring means for transferring a developer image formed on said electrostatic latent image bearing member to a transferring material; and

cleaning means for cleaning the surface of the electrostatic latent image bearing member by bringing a cleaning blade consisting of an elastic blade into contact with the surface of said electrostatic latent image bearing member,

wherein said cleaning blade has a portion to be brought into contact with the surface of said electrostatic latent image bearing member and at least resin films on surfaces at both ends outside a developing area in a longitudinal direction.

2. The apparatus according to claim 1,

wherein the resin films of the cleaning blade contain lubricating fine particles.

3. The apparatus according to claim 1,

wherein the elastic blade is made of urethane-based rubber and the resin films are made of polyamide resin.

4. The apparatus according to claim 1,

wherein the elastic blade of the cleaning blade has resin films on surfaces at both ends corresponding to areas outside the developing area in the longitudinal direction and inside a primary charging area in the longitudinal direction.

5. The apparatus according to claim 4,

wherein the elastic blade has no resin film at an area corresponding to the developing area in the longitudinal direction.

6. The apparatus according to claim 5,

wherein the resin film is made of resin selected out of a group consisting of polyamide resin, polyimide resin, silicone resin, polyacetal resin and fluorine-containing resin, and the elastic blade is made of rubber.

7. The apparatus according to claim 6,

wherein the elastic blade is made of urethane-based rubber and the resin film is made of polyamide resin.

8. The apparatus according to claim 7,

wherein the resin film contains lubricating fine particles.

9. A process-cartridge comprising at least:

an electrostatic latent image bearing member; and

cleaning means for cleaning a surface of said electrostatic latent image bearing member,

wherein at least said electrostatic latent image bearing member and the cleaning means for cleaning the surface of said electrostatic latent image bearing member are integrated and detachable from a main body of an image forming apparatus, and

a cleaning blade has a portion to be brought into contact with the surface of said electrostatic latent image bearing member and at least resin films on surface at both ends outside a developing area in a longitudinal direction.

10. The process-cartridge according to claim 9,

wherein the resin film of the cleaning blade contains lubricating fine particles.

11. The process-cartridge according to claim 9,

wherein an elastic blade is made of urethane-based rubber and the resin film is made of polyamide resin.

12. The process-cartridge according to claim 9,

wherein an elastic blade of the cleaning blade has resin films on surfaces at both ends corresponding to areas outside the developing area in the longitudinal direction and inside a primary charging area in the longitudinal direction.

13. The process-cartridge according to claim 12,

wherein the elastic blade has no resin film at an area corresponding to the developing area in the longitudinal direction.

14. The process-cartridge according to claim 13,

wherein the resin film is made of resin selected out of a group consisting of polyamide resin, polyimide resin, silicone resin, polyacetal resin and fluorine-containing resin, and the elastic blade is made of rubber.

15. The process-cartridge according to claim 14,

wherein the elastic blade is made of urethane-based rubber and the resin film is made of polyamide resin.

16. The process-cartridge according to claim 15,

wherein the resin film contains lubricating fine particles.

* * * * *