Description

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a cleaning blade which is employed in a cleaning device of an image forming apparatus such as electrostatic copying machines, printers, and facsimile apparatuses, and is used for eliminating remaining toner from a surface of an image-holding member by pressure-contact thereto.

The present invention also relates to an apparatus employing the cleaning blade.

Related Background Art

In a known image forming apparatus, in which transferable toner images formed on an image-holding member are repeatedly transferred onto a transfer material such as paper, toner remaining on an image-holding member has to be removed completely in every transfer step. Generally the remaining toner is eliminated by pressing uniformly a blade, which is made of a rubber elastomer and has a precise edge, against the surface of the image-holding member and sliding the blade on the surface. The cleaning blade is usually made of urethane rubber.

The cleaning process employing the urethane rubber, however, is disadvantageous in that the simple pressure-contact of the cleaning blade with the image-holding member causes reversal or bounding of the cleaning blade 3 of urethane rubber supported by supporting member 2 as shown by a dotted line in Fig. 1 because of the high friction coefficient of the urethane rubber and the resulting strong friction between the urethane rubber and the image-holding member, thus the remaining toner being not removed.

For this reason, measures have been investigated and practiced such that the tip of the cleaning blade made of polyurethane rubber or the surface of the photosensitive member is covered with a lubricating fine powder or the like of a fluorine type resin such as polyvinylidene fluoride and polytetrafluoroethylene to reduce the friction between the urethane rubber and the photosensitive member at an initial sliding stage. Such lubricating fine powder is required to be applied uniformly in a minimum amount since excessive application affects the image because of its electric characteristics. However, such application is not easy technically, still involving problems on reliability as to the reversal or bounding of the blade caused by non-uniform coating.

There is another problem that during repetition of the cleaning process, the lubricating fine powder is scattered and lost from the vicinity of the edge, reducing its lubricating effect, and the toner which comes instead to play the role of the lubricating powder gives less friction-reducing effect, thus the urethane blade scratching or abrading a photosensitive member, especially an organic photosemiconductor to shorten the life thereof.

As the urethane rubber material used for such a type of cleaning blade, a casting type of thermosetting liquid urethane is used usually because of its abrasion resistance to a photosensitive member and the like, and non-occurrence of contaminating the photosensitive member, the toner and the like caused by exudate from the urethane rubber. This type of urethane materials require a long reaction time for heat cure, and are highly reactive to moisture in the atmosphere, involving problems in production equipment cost, and control of the material quality. Accordingly, a production process free from such problems are desired.

According to the EP-A- 0 384 354, which represents a post-published prior right falling within the terms of Article 54(3) EPC, the cleaning blade being made of an elastic material such as polyurethane rubber or silicone rubber comprises powder of a graphite fluoride. The graphite fluoride powder has an average particle diameter of not more than 20 μm, particularly in the range of 1 μm to 8 μm.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a cleaning blade having a small friction coefficient, and not scratching the surface of an image-holding member.

Another object of the present invention is to provide a cleaning blade which is produced readily with invariable quality.

A further object of the present invention is to provide an apparatus equipped with the image-holding member.

According to an aspect of the present invention, there is provided a cleaning blade of a cleaning device for eliminating remaining toner powder from a surface of an image-holding member, the cleaning blade being constituted of silcone rubber, and the silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, having

rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

According to another aspect of the present invention, there is provided an apparatus unit mountable to and demountable from a main apparatus, the unit being constructed from at least one of a charging means and a developing means, together with a cleaning blade in one unit, the cleaning blade being constituted of silicone rubber, and the silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, having rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

According to still another aspect of the present invention, there is provided an electrophotographic apparatus comprising a photosensitive member, a latent image forming member, a developing means for developing a formed latent image, a transfer means for transferring a developed image onto a transfer-receiving material, and a cleaning blade, the cleaning blade being constituted of silicone rubber, and the silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, having rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

According to a further aspect of the present invention, there is provided a facsimile apparatus comprising an electrophotographic apparatus and receiving means for receiving an image information from a remote terminal, the electrophotographic apparatus comprising a photosensitive member, a latent image forming member, a developing means for developing a formed latent image, a transfer means for transferring a developed image onto a transfer-receiving material, and a cleaning blade, the cleaning blade being constituted of silicone rubber, and the silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, having rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates reversal of a cleaning blade.

Fig. 2 is an enlarged illustration of a sliding portion of a cleaning blade brought into contact with a photosensitive member drum.

Fig. 3 illustrates roughly a constitution of a usual transfer type of electrophotographic apparatus employing a cleaning blade of the present invention.

Fig. 4 is a block diagram of a facsimile apparatus employing as a printer an electrophotographic apparatus having a cleaning blade of the present invention.

Fig. 5 illustrates a state of abrasion of a cleaning blade after use for a long period.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The cleaning blade of the present invention has a small friction coefficient, and is abraded by itself gradually as shown in Fig. 2 into fine powder 5 without scratching the surface of a photosensitive member drum 1, and the resulting minor amount of the powder functions as a lubricating medium, allowing a toner 4 to be eliminated with low friction sliding. The cleaning blade is produced by a technique of rubber injection molding, and is simple and reliable.

The cleaning blade of the present invention does not undergo the reversal of the blade at the initial stage of sliding on a photosensitive member, lengthen the life of an image-holding member like a photosensitive member without scratching thereof, and is produced with high-quality and high productivity, thus giving a satisfactory cleaning effect.

The silicone rubber is designed to have a rubber hardness appropriate for pressing it to an image-holding member from a larger distance and with a larger load than a predetermined distance and load in order to give a desired contact pressure, in view of removability of remaining toner. A lower hardness of the rubber causes insufficiency of the pressure or elasticity of the rubber, rendering the cleaning blade to come into contact with an image-holding member through a larger face, thus causing increase of friction on sliding and decrease of the sliding ability. Therefore, the hardness is not less than 40° according to JIS A. On the contrary, a cleaning member having a higher hardness causes scratch on the image-holding member. Therefore the hardness is not higher than 90° according to JIS A. Preferably, the hardness is within the range of from 50° to 80° according to JIS A.

The hardness is measured by the Spring Type Hardness Test (Type A) according to the Japanese Industrial

Standard JIS K 6301: Physical Testing Methods for Vulcanized Rubber (1975; item 5).

The contact pressure of the cleaning member to the image-holding member have to be maintained to be higher than the predetermined minimum value of variation in the pressure, since at a pressure lower than the minimum the elimination of the remaining toner will become impracticable. Rubbers will deform irreversibly by internal plastic flow on receiving a contact pressure, namely creeping. The cleaning member is desired to cause less creeping. As the criterion, the permanent compression set of the rubber is not more than 20 %, preferably not more than 10 % according to JIS K 6301.

The permanent compression set is measured by the Compression Set Test according to the JIS K 6301 mentioned above (item 10).

Silicone rubbers usually contain a low-molecular-weight polysiloxane oil having a low viscosity of about 2.10^{-2} Pa·s (20 centipoise) or less which has been formed in synthesis of a raw material for the silicone rubbers. At a higher content of this component, on contact-pressing the silicone rubber cleaning blade having an edge, the pressure onto the surface reaches several tens kg/cm^2, which exudes the low-viscosity oil onto the surface of the image-holding member, thereby affecting the electrostatic photographic process. Therefore a silicone rubber preferably contains a less amount of the low-viscosity oil component. The content is not higher than 5 % by weight, preferably not more than 3 % by weight.

The silicone rubber is of any material of a room temperature-curable type of RTV, a low temperature-curable type of LTV, a high temperature-curable type of HTV, and the like, provided that it satisfies the aforementioned requirements. However, the LTV, an addition reaction type of liquid silicone rubbers, is preferable which has a sufficient rubber flow property, reacts quickly by heating, leaving no unreacted matter, and gives relatively less molding shrinkage.

For the purpose of imparting a minimum level of abrasion resistance, a filler having a minor average diameter of primary particles is added to the silicone rubber constituting the cleaning blade. If the particle diameter is larger than that of the toner particles employed in the electrostatic photography, problems arises that the filler particles make rougher the edge portion formed on the cleaning blade of silicone rubber which contains the dispersed filler particles and comes into pressure-contact with the image-holding member, thereby rendering the toner cleaning impracticable, and that the cleaning performance is lowered because the abraded and chipped portion of the silicone rubber cleaning blade becomes larger than the toner particle diameter. Accordingly, the filler has preferably a diameter less than that of the toner. The diameter of the filler is thus not more than 1 µm. The filler to be added is preferably in an amount of not less than 5 % by weight in view of viscoelastic mechanical property, impartment of minimum abrasion property, and elongation of duration of life of the silicone rubber cleaning blade.

The filler to be added may be any material provided that the aforementioned property requirements are satisfied. The examples include fine organic resin powder, such as ultra-high density polyethylene, nylon, and fluorine-type resins, and fine inorganic powder such as molybdenum disulfide, fluorocarbon, and silica, and multi-component systems derived therefrom. Among them, fine powder silica including wet-process silica and dry-process silica is preferable in view of the particle diameter, the dispersibility in silicone rubber, and no scratch of the surface of an image-holding member. In particular, hydrophobicity-treated silica having improved dispersibility is preferable. Further, fumed silica and hydrophobicity-treated fumed silica are preferable in view of the particle diameter.

In the cleaning process, the cleaning blade is required to be brought into precise contact with a curved surface of a cylindrical photosensitive drum or the like to achieve satisfactory cleaning performance, for which the cleaning blade itself have to be dimensionally precise. For this purpose, the cleaning blade is most desirably molded by injection molding using a dimensionally highly precise mold clamped at high pressure. Thereby the dimensional precision is improved and the injection reaction time is shortened owing to a high shear flow of rubber at the injection, which is advantageous in production. The bonding of the molded silicone rubber with a supporting member is liable to be insufficient. To solve this problem, a supporting member having an adhesive applied preliminarily on the portion to be bonded is inserted into the mold, and the silicone rubber is molded in integrity with the supporting member, thus strong bonding being attained by utilizing rubber formation reaction. In such a manner, a cleaning blade having a higher quality is prepared in a shorter molding time in comparison with the one made of urethane rubber.

Fig. 3 illustrate roughly a constitution of a usual transfer type of electrophotographic apparatus employing a drum-shaped photosensitive member.

In Fig. 3, a drum-shaped photosensitive member 11 as an image-holding member is driven to rotate around an axis 11a in an arrow direction at a predetermined peripheral velocity. During the rotation, the photosensitive member 11 is electrified uniformly to a predetermined positive or negative potential with an electrifying means 12, and subsequently is exposed to light image projection L from a light image projection means not shown in the figure (slit exposure, laser beam-scanning exposure, etc.) at an exposure section 13, thereby electrostatic

latent images being successively formed on the peripheral surface of the photosensitive member in correspondence with the projected image.

The electrostatic latent image is subsequently subjected to toner developement with a developing means 14, and the developed toner image is successively transferred by a transfer means 15 onto a surface of a transfer-receiving material P which is fed synchronously with the rotation of the photosensitive member 11 to the space between the photosensitive member 11 and the transfer means 15 from a paper-feeding portion not shown in the figure.

The transfer-receiving material P having received the transferred image is separated from the surface of the photosensitive member and introduced into an image-fixing means 18 to have the image fixed, and is then sent out of the apparatus as a copied material.

The surface of the photosensitive member 11 after the image transfer is cleaned for removal of remaining toner by using a cleaning blade 16 of the present invention, and treated with a preliminary exposure means 17 to erase electro static charge and used repeatedly for image formation.

The uniform electrifying means 12 for the photosensitive member 11 generally used is a corona electrifying apparatus. The transfer means 15 generally used are also a corona electrifying means.In the electrophotographic apparatus, out of the structural elements such as a photosensitive member, a developing means, and a cleaning means, a plurality of the units may be integrated into one apparatus unit so that the apparatus unit may be mountable to and demountable from the main body of the apparatus. For example, at least one of the electrifying means and the developing means is integrated with the photosensitive member and the cleaning blade into one unit which is mountable and demountable by a guiding means such as a rail in the main body of the apparatus. The aforementioned apparatus unit may comprise an electrifying means and/or a developing means.

In the case where the electrophotographic apparatus is used as a copying machine or a printer, the light image projection L is given as reflected light or transmitted light from an original copy, or otherwise given by scanning of a laser beam, driving of an LED array, or driving of a liquid crystal shutter array in accordance with the signal made by read-out of an original copy.

In the case where the electrophotographic apparatus is used as a printer of a facsimile apparatus, the light image projection L is conducted for printing out the received data. Fig. 4 shows a block diagram of an example for such a case.

A controller 21 controls an image reading section 20 and a printer 29. The whole of the controller 21 is controlled by CPU 27. The read-out data from the image reading section is transmitted to the other communication party through a transmitting circuit 23. Data received from the other communication party is sent through a receiving circuit 22 to the printer 29. The image data is stored in an image memory. A printer controller 28 controls a printer 29. The numeral 24 denotes a telephone.

An image received through a circuit 25 (image information from a remote terminal connected through the circuit), after demodulated with the receiving circuit 22, decoded by CPU 27 and successively stored in the image memory 26. When at least one page of image have been stored in the image memory 26, recording of the image of the page is conducted. The CPU 27 reads out one page of image information from the image memory 26, and sends out the decoded one page of image information to the printer controller 28 which controls a printer 29 so as to record the one page of image information on receiving it from CPU 27.

The CPU 27 receives the following page during the recording by the printer 29.

Images are received and recorded in a manner as described above.

(Method for preparing Cleaning Blade)

Liquid A of TSE 3032 (trade name, made by Toshiba Silicone K.K.) containing a polysiloxane oil having a terminal vinyl group, a platinum type catalyst, and silica, and Liquid B of TSE 3032 containing a polysiloxane oil having a terminal vinyl group, a reaction controlling agent, a hydrosilane, and silica were employed.

The mixing ratio of Liquid A and Liquid B, the content of silica in each Liquid, and the particle diameter of the silica were adjusted so as to obtain the molded cleaning blade having the hardnesses as shown in Table 1.

The starting material mixture formulated as above was injection-molded into a mold heated preliminarily at 170°C and having a supporting member inserted therein which had been treated for adhesion with a vulcanizing adhesive. After 60 seconds from the injection, the molded blade was removed from the mold, and was subjected to secondary cure at 200°C for 4 hours. Subsequently it was subjected to edge formation. The resulting article was used as a cleaning blade.

The cleaning blade formed above was evaluated for reversal at the initial sliding, degree of scratch of the surface of the photosensitive member after 3000 sheets of paper passed, and cleanability by use of an elec-

trophotographic copying machine (Personal Copia FC-5, trade name, made by Canon K.K.) employing an organic photosensitive member.

Exmaple 1

Main material and curing material were prepared by dispersing therein the following amount of silica.

Main material:

TSE 3032A 100 g
(Two liquid addition reaction type silicone manufactured by Toshiba Silicone)
RX-200 (primary particle size: 14 nm (mμ) 10 g
(Hydrohobicity-treated fumed silica manufactured by Japan Aerosil)

Curing Material:

TSE3032B	10 g
RX-200	1 g

Conditions of molding:

A supporting member pre-treated with vulcanizable adhesive for adhesion was inserted in a injection molding machine. The main material and the curing material were mixed in a ratio of 10:1 and molded by using the injection molding machine. The molded product was worked into a predetermined shape.

Molding temperature	170 °C
Molding time	60 sec
Secondary curing temperature	200 °C
Secondary curing time	4 hours

Properties of molded article:

Rubber hardness	JIS A 56°
Permanent compression set (70 °C)	7%

Exmaple 2

Main material and curing material were prepared by dispersing therein the following amount of silica.

Main material:

TSE 3032A 100 g
(Two liquid addition reaction type silicone manufactured by Toshiba Silicone)
RX-200 (primary particle size: 14 nm (mμ) 20 g
(Hydrohobicity-treated fumed silica manufactured by Japan Aerosil)

Curing Material:

TSE3032B	10 g
RX-200	2 g

Conditions of molding:

A supporting member pre-treated with vulcanizable adhesive for adhesion was inserted in a injection molding machine. The main material and the curing material were mixed in a ratio of 10:1 and molded by using the injection molding machine. The molded product was worked into a predetermined shape.

Molding temperature	170 °C
Molding time	60 sec
Secondary curing temperature	200 °C
Secondary curing time	4 hours

Properties of molded article:

Rubber hardness	JIS A 66°
Permanent compression set (70 °C)	7%

Exmaple 3

Main material and curing material were prepared by dispersing therein the following amount of silica.

Main material:

TSE 3032A 100 g
(Two liquid addition reaction type silicone manufactured by Toshiba Silicone)
RX-200 (primary particle size: 14 nm (mμ) 10 g
(Hydrohobicity-treated fumed silica manufactured by Japan Aerosil)

Curing Material:

TSE3032B	10 g
RX-200	1 g

Conditions of molding:

A supporting member pre-treated with vulcanizable adhesive for adhesion was inserted in a injection molding machine. The main material and the curing material were mixed in a ratio of 10:3 and molded by using the injection molding machine. The molded product was worked into a predetermined shape.

Molding temperature	170 °C
Molding time	60 sec
Secondary curing temperature	200 °C
Secondary curing time	4 hours

Properties of molded article:

Rubber hardness	JIS A 76°
Permanent compression set (70 °C)	6%

Exmaple 4

Main material and curing material were prepared by dispersing therein the following amount of silica.

Main material:

TSE 3032A 100 g
(Two liquid addition reaction type silicone manufactured by Toshiba Silicone)
RX-200 (primary particle size: 14 nm (mμ) 10 g
(Hydrohobicity-treated fumed silica manufactured by Japan Aerosil)

Curing Material:

TSE3032B	10 g
RX-200	1 g

Conditions of molding:

A supporting member pre-treated with vulcanizable adhesive for adhesion was inserted in a injection molding machine. The main material and the curing material were mixed in a ratio of 10:0.7 and molded by using the injection molding machine. The molded product was worked into a predetermined shape.

Molding temperature	170 °C
Molding time	60 sec
Secondary curing temperature	200 °C
Secondary curing time	4 hours

Properties of molded article:

Rubber hardness	JIS A 46°
Permanent compression set (70 °C)	8%

Exmaple 5

Main material and curing material were prepared by dispersing therein the following amount of silica.

Main material:

TSE 3032A 100 g
(Two liquid addition reaction type silicone manufactured by Toshiba Silicone)
Tokusil u (primary particle size: 20 nm (mμ) 40 g
(Trade name; Wet-process silica manufactured by Tokuyama Soda)

Curing Material:

TSE3032B	10 g
RX-200	1 g

Conditions of molding:

A supporting member pre-treated with vulcanizable adhesive for adhesion was inserted in a injection molding machine. The main material and the curing material were mixed in a ratio of 10:1 and molded by using the injection molding machine. The molded product was worked into a predetermined shape.

Molding temperature	170 °C
Molding time	60 sec
Secondary curing temperature	200 °C
Secondary curing time	4 hours

Properties of molded article:

Rubber hardness	JIS A 56°
Permanent compression set (70 °C)	9%

Comparative example 1

Rubber material:

Ethylene-adipate type urethane prepolymer
(made by Nippon Polyurethane Kogyo K.K.;
Mn: 1500, NCO: 6.2 % by weight) 100 gr

Curing agent:

1,4-butanediol	3.9 gr
Trimethylolpropane	2.1 gr
Molding temperature	130 °C
Molding time	30 minutes
Secondary curing temperature	130 °C
Secondary curing time	4 hours

The urethane prepolymer was melted by heating, and thereto the curing agent was mixed. The mixture was cast in a heated mold and was heat-cured. The molded product was worked into a predetermined shape.

Properties of molded article:

Rubber hardness: JIS A 62°
Permanent, compression set (70°C) 9 %

Comparative example 2

The experiment was conducted in the same manner as in Example 1 except that aluminum silicate, Kyoritsu Hard Clay H-1 (trade name, made by Kyoritsu Yogyo K.K.) was used in place of the silica.

Comparative example 3

Silicone rubber material:

Commercial grades of a main material and a curing material, each containing silica and other filler dispersed therein,

TSE 1026, Main material A (two-part addition type liquid silicone, made by Toshiba Silicone K.K.)	100 gr
TSE 1026, Curing material B	100 gr

Molding condition:

The main material and the curing material in a ratio of 1:1 was molded by injection molding by using a mold having a supporting member inserted therein and preliminarily treated for adhesion, and subjected to secondary curing, and then worked for edge formation, thus providing a cleaning blade.

Molding temperature	170 °C
Molding time	60 seconds
Secondary curing temperature	200 °C
Secondary curing time	4 hours

Properties of molded article:

Rubber hardness: JIS A 62°
Permanent compression set (70°C): 12%

Comparative example 4

Silicone rubber material:

Commercial grades of a main material and a curing material, each containing silica and other filler dispersed therein,

TSE 1026, Main material A (two-part addition type liquid silicone, made by Toshiba Silicone K.K.)	100 gr
TSE 1026, Curing material B	100 gr

Molding condition:

The main material and the curing material in a ratio of 1:1 was molded by injection molding by using a mold having a supporting member inserted therein and preliminarily treated for adhesion, and then worked for edge formation, thus providing a cleaning blade.

Molding temperature 170 °C
Molding time 60 seconds

Properties of molded article:

Rubber hardness: JIS A 58°
Permanent compression set (70°C): 30 %

The cleaning blade formed above was evaluated for reversal at the initial sliding stage, the degree of scratch of the surface of the photosensitive member after 3000 sheets of paper passed, and the cleanability by using an electrophotographic copying machine (Personal Copia FC-5, trade name, made by Canon K.K.) employing an organic photosensitive member.

Table 1

	Example					Comparative example			
	1	2	3	4	5	1	2	3	4
Kind of rubber	silicone	Silicone	Silicone	Silicone	Silicone	Urethane	Silicone	Silicone	Silicone
Particle size of silica (nm [mμ])	14	14	14	14	20	-	2000	Mixture	Mixture
Amount of silica (% by weight)	10	20	10	10	10	-	10		
Rubber hardness (JIS A)	56	66	76	46	56	62	60	60	60
Permanent compression set(%)	7	7	6	8	9	9	12	12	30
Oil content (% by weight)	3	2.6	3	3	3	-	3	12	15
Reversal at initial stage	O	O	O	O	O	×	O	O	O
Scratch of photosensitive member	no	no	no	no	no	yes	yes	yes	-
Cleanability	good	good	good	good	good	good	poor	poor	poor
Oil exudation	no	no	no	no	no	no	no	yes	yes
Abrasion (μm^2)	50	25	38	75	60	0	1000	800	-

REMARK:

1) Oil content: 5 grams of the rubber sample was cut into small pieces and was extracted with 100 cc of hexane by use of a Soxhlet extractor for 20 hours. The hexane was evaporated off, and the weight of the remaining extract was represented in % by weight.

2) Reversal at initial sliding stage: The symbol O denote no reversal observed, and the symbol × denotes reversal observed.

In the case of the urethane blade, when vinylidene fluoride powder is applied at the tip of the blade, no reversal occurs, but when it is not applied, reversal occurs. Accordingly the test for scratching of the photosensitive member, cleanability, and oil exudation was conducted with application of the powder.

3) Scratching of photosensitive member: In image printing at an optimum density level with a Canon Family Copia FC-5 (trade name), when a black line is observed in the photosensitive drum periphery direction, the scratching of the photosensitive member is evaluated as "yes", and otherwise evaluated as "no".

4) Cleanability: In image printing in the same manner as described in the above item 3), when a black line is observed in the photosensitive drum periphery direction and further toner remains on the photosensitive member after cleaning, the cleanability is evaluated as "poor", and when no black line is observed, evaluated as "good".

5) Oil exudation: In image printing in the same manner as described in the above item 3), when a black line is observed on the photosensitive member at a pressure-contacting position of the cleaning blade in a length direction of the drum, oil exudation is evaluated as "yes", and when no black line is observed, oil exudation is evaluated as "no".

6) Permanent compression set: Measured according to JIS K 6301.

7) Particle diameter: Denoted by the average diameter in mμ of primary particles, measured by electromicroscopy.

8) Abrasion: represented by the area (μm^2) of the abraded portion 6 of the abraded blade 3 as shown in Fig. 5.

As is clear from the above results, all of the cleaning blades of Examples 1 to 5 of the present invention was found to undergo no reversal at the initial sliding stage, having excellent cleanability, and causing no oil exudation.

On the contrary, the cleaning blade of Comparative example 1 undergo reversal in the absence of fine powder of vinylidene fluoride, while it scratches the photosensitive member in the presence of the fine powder added, shortening the life of the photosensitive member. The cleaning blade of Comparative example 2, scratches the photosensitive member and has low cleanability owing to the large particle size of the filler, giving inferior image. The cleaning blade of Comparative example 3 has edge roughness of several μ to ten or more μ after edge working, unsatisfactory both in scratching of the photosensitive member and in cleanability, and additionally causing oil exudation owing to a larger oil content. The cleaning blade of Comparative example 4 is made of the rubber same as that of Comparative example 3 but is not subjected to the secondary curing, causing larger permanent compression set, thus resulting in poor cleaning after 200 to 300 sheets of printing, and yet involves a problem of oil exudation owing to a high oil content.

Claims

1. A cleaning blade (3) of a cleaning device for eliminating remaining toner powder (4) from a surface of an image-holding member (1), said cleaning blade (3) being constituted of silicone rubber, and said silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, the rubber having rubber hardness within the range of from 40° to 90° according to JIS A and causing permanent compression set of not more than 20 % according to JIS K 6301.

2. The cleaning blade of Claim 1, wherein the filler contained in the silicone rubber is silica.

3. The cleaning blade of Claim 2, wherein the silica has been treated for hydrophobicity.

4. The cleaning blade of Claim 1, wherein a supporting member (2) of holding the cleaning blade (3) is placed in a mold for molding the cleaning blade (3), and the cleaning blade (3) is molded with the supporting member (2) in one body by injection molding.

REMARK:

1) Oil content: 5 grams of the rubber sample was cut into small pieces and was extracted with 100 cc of hexane by use of a Soxhlet extractor for 20 hours. The hexane was evaporated off, and the weight of the remaining extract was represented in % by weight.

2) Reversal at initial sliding stage: The symbol O denote no reversal observed, and the symbol × denotes reversal observed.

In the case of the urethane blade, when vinylidene fluoride powder is applied at the tip of the blade, no reversal occurs, but when it is not applied, reversal occurs. Accordingly the test for scratching of the photosensitive member, cleanability, and oil exudation was conducted with application of the powder.

3) Scratching of photosensitive member: In image printing at an optimum density level with a Canon Family Copia FC-5 (trade name), when a black line is observed in the photosensitive drum periphery direction, the scratching of the photosensitive member is evaluated as "yes", and otherwise evaluated as "no".

4) Cleanability: In image printing in the same manner as described in the above item 3), when a black line is observed in the photosensitive drum periphery direction and further toner remains on the photosensitive member after cleaning, the cleanability is evaluated as "poor", and when no black line is observed, evaluated as "good".

5) Oil exudation: In image printing in the same manner as described in the above item 3), when a black line is observed on the photosensitive member at a pressure-contacting position of the cleaning blade in a length direction of the drum, oil exudation is evaluated as "yes", and when no black line is observed, oil exudation is evaluated as "no".

6) Permanent compression set: Measured according to JIS K 6301.

7) Particle diameter: Denoted by the average diameter in mμ of primary particles, measured by electromicroscopy.

8) Abrasion: represented by the area (μm^2) of the abraded portion 6 of the abraded blade 3 as shown in Fig. 5.

As is clear from the above results, all of the cleaning blades of Examples 1 to 5 of the present invention was found to undergo no reversal at the initial sliding stage, having excellent cleanability, and causing no oil exudation.

On the contrary, the cleaning blade of Comparative example 1 undergo reversal in the absence of fine powder of vinylidene fluoride, while it scratches the photosensitive member in the presence of the fine powder added, shortening the life of the photosensitive member. The cleaning blade of Comparative example 2, scratches the photosensitive member and has low cleanability owing to the large particle size of the filler, giving inferior image. The cleaning blade of Comparative example 3 has edge roughness of several μ to ten or more μ after edge working, unsatisfactory both in scratching of the photosensitive member and in cleanability, and additionally causing oil exudation owing to a larger oil content. The cleaning blade of Comparative example 4 is made of the rubber same as that of Comparative example 3 but is not subjected to the secondary curing, causing larger permanent compression set, thus resulting in poor cleaning after 200 to 300 sheets of printing, and yet involves a problem of oil exudation owing to a high oil content.

Claims

1. A cleaning blade (3) of a cleaning device for eliminating remaining toner powder (4) from a surface of an image-holding member (1), said cleaning blade (3) being constituted of silicone rubber, and said silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, the rubber having rubber hardness within the range of from 40° to 90° according to JIS A and causing permanent compression set of not more than 20 % according to JIS K 6301.

2. The cleaning blade of Claim 1, wherein the filler contained in the silicone rubber is silica.

3. The cleaning blade of Claim 2, wherein the silica has been treated for hydrophobicity.

4. The cleaning blade of Claim 1, wherein a supporting member (2) of holding the cleaning blade (3) is placed in a mold for molding the cleaning blade (3), and the cleaning blade (3) is molded with the supporting member (2) in one body by injection molding.

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5. The cleaning blade of Claim 1, wherein the cleaning blade (3) is formed from an addition reaction type of liquid silicone rubber.

6. An apparatus unit mountable to and demountable from a main apparatus, said unit being constructed from at least one of a charging means (12) and a developing means (14), together with a cleaning blade (16) in one unit, said cleaning blade being constituted of silicone rubber, and said silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, the rubber having rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

7. An electrophotographic apparatus comprising a photosensitive member (11), a latent image forming member (12, 13), a developing means (14) for developing a formed latent image, a transfer means (15) for transferring a developed image onto a transfer-receiving material, and a cleaning blade, said cleaning blade (16) being constituted of silicone rubber, said silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, the rubber having rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

8. A facsimile apparatus comprising an electrophotographic apparatus and receiving means (21, 25) for receiving an image information from a remote terminal, said electrophotographic apparatus comprising a photosensitive member (11), a latent image forming member (12, 13), a developing means (14) for developing a formed latent image, a transfer means (15) for transferring a developed image onto a transfer-receiving material, and a cleaning blade (16), said cleaning blade being constituted of silicone rubber, said silicone rubber containing a filler having a particle diameter of not more than 1 μm and containing not more than 5 % by weight of a low-viscosity organosiloxane component, the rubber having rubber hardness within the range of from 40° to 90° according to JIS A, and causing permanent compression set of not more than 20 % according to JIS K 6301.

Patentansprüche

1. Reinigungsrakel (3) einer Reinigungsvorrichtung für die Entfernung restlichen Tonerpulvers (4) von einer Oberfläche eines Bildhalteteils (1), wobei die erwähnte Reinigungsrakel (3) aus Silicongummi gebildet ist und der erwähnte Silicongummi einen Füllstoff mit einem Teilchendurchmesser von nicht mehr als 1 μm enthält und nicht mehr als 5 Masse% einer Organosiloxankomponente mit niedriger Viskosität enthält und wobei der Gummi eine Gummihärte im Bereich von 40° bis 90° gemäß JIS A hat und eine bleibende Druckverformung von nicht mehr als 20 % gemäß JIS K 6301 verursacht.

2. Reinigungsrakel nach Anspruch 1, bei der der Füllstoff, der in dem Silicongummi enthalten ist, Siliciumdioxid ist.

3. Reinigungsrakel nach Anspruch 2, bei der das Siliciumdioxid einer Hydrophobierungsbehandlung unterzogen worden ist.

4. Reinigungsrakel nach Anspruch 1, bei der ein Trägerteil (2) zum Halten der Reinigungsrakel (3) in eine Form zum Formen der Reinigungsrakel (3) eingebracht wird und die Reinigungsrakel (3) durch Spritzgießen in einem Stück mit dem Trägerteil (2) geformt wird.

5. Reinigungsrakel nach Anspruch 1, bei der die Reinigungsrakel (3) aus flüssigem Siliconkautschuk des Additionsreaktionstyps gebildet ist.

6. Geräteeinheit, die an einem Hauptgerät anbringbar und davon abnehmbar ist, wobei die erwähnte Einheit aus mindestens einer von einer Aufladungseinrichtung (12) und einer Entwicklungseinrichtung (14) zusammen mit einer Reinigungsrakel (16) in einer Einheit gebaut ist, wobei die erwähnte Reinigungsrakel aus Silicongummi gebildet ist und der erwähnte Silicongummi einen Füllstoff mit einem Teilchendurchmesser von nicht mehr als 1 μm enthält und nicht mehr als 5 Masse% einer Organosiloxankomponente mit niedriger Viskosität enthält und wobei der Gummi eine Gummihärte im Bereich von 40° bis 90° gemäß JIS A hat und eine bleibende Druckverformung von nicht mehr als 20 % gemäß JIS K 6301 verursacht.

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7. Elektrophotographisches Gerät, das ein photoempfindliches Teil (11), ein Teil (12, 13) zur Erzeugung latenter Bilder, eine Entwicklungseinrichtung (14) zur Entwicklung eines erzeugten latenten Bildes, eine Übertragungseinrichtung (15) zur Übertragung eines entwickelten Bildes auf ein Übertragungs- bzw. Bildempfangsmaterial und eine Reinigungsrakel umfaßt, wobei die erwähnte Reinigungsrakel (16) aus Silicongummi gebildet ist, wobei der erwähnte Silicongummi einen Füllstoff mit einem Teilchendurchmesser von nicht mehr als 1 µm enthält und nicht mehr als 5 Masse% einer Organosiloxankomponente mit niedriger Viskosität enthält und wobei der Gummi eine Gummihärte im Bereich von 40° bis 90° gemäß JIS A hat und eine bleibende Druckverformung von nicht mehr als 20 % gemäß JIS K 6301 verursacht.

8. Faksimilegerät, das ein elektrophotographisches Gerät und eine Empfangseinrichtung (21, 25) zum Empfangen von Bilddaten aus einer entfernten Datenstation umfaßt, wobei das erwähnte elektrophotographische Gerät ein photoempfindliches Teil (11), ein Teil (12, 13) zur Erzeugung latenter Bilder, eine Entwicklungseinrichtung (14) zur Entwicklung eines erzeugten latenten Bildes, eine Übertragungseinrichtung (15) zur Übertragung eines entwickelten Bildes auf ein Übertragungs- bzw. Bildempfangsmaterial und eine Reinigungsrakel (16) umfaßt, wobei die erwähnte Reinigungsrakel aus Silicongummi gebildet ist, wobei der erwähnte Silicongummi einen Füllstoff mit einem Teilchendurchmesmesser von nicht mehr als 1 µm enthält und nicht mehr als 5 Masse% einer Organosiloxankomponente mit niedriger Viskosität enthält und wobei der Gummi eine Gummihärte im Bereich von 40° bis 90° gemäß JIS A hat und eine bleibende Druckverformung von nicht mehr als 20 % gemäß JIS K 6301 verursacht.

Revendications

1. Lame (3) de nettoyage d'un dispositif de nettoyage destiné à éliminer de la poudre de toner restante (4) d'une surface d'un élément (1) porteur d'image, ladite lame (3) de nettoyage étant constituée de caoutchouc siliconé, et ledit caoutchouc siliconé contenant une charge ayant des particules d'un diamètre non supérieur à 1 µm et ne contenant pas plus de 5 % en poids d'un constituant du type organosiloxane à faible viscosité, le caoutchouc ayant une dureté de caoutchouc dans la plage de 40° à 90° conformément à la norme JIS A et provoquant une déformation permanente par compression non supérieure à 20 % conformément à la norme JIS K 6301.

2. Lame de nettoyage selon la revendication 1, dans laquelle la charge contenue dans le caoutchouc siliconé est de la silice.

3. Lame de nettoyage selon la revendication 2, dans laquelle la silice a été traitée pour l'hydrophobie.

4. Lame de nettoyage selon la revendication 1, dans laquelle un élément (2) de support destiné à porter la lame de nettoyage (3) est placé dans un moule pour le moulage de la lame de nettoyage (3), et la lame de nettoyage (3) est moulée d'un seul bloc avec l'élément (2) de support par moulage par injection.

5. Lame de nettoyage selon la revendication 1, dans laquelle la lame de nettoyage (3) est formée d'un type de caoutchouc siliconé liquide à réaction par addition.

6. Unité d'appareil pouvant être montée sur un appareil principal et en être démontée, ladite unité étant constituée d'au moins un moyen de charge (12) et un moyen de développement (14), ainsi que d'une lame (16) de nettoyage en une unité, ladite lame de nettoyage étant constituée de caoutchouc siliconé, et ledit caoutchouc siliconé contenant une charge ayant un diamètre de particules non supérieur à 1 µm et ne contenant pas plus de 5 % en poids d'un constituant du type organosiloxane à faible viscosité, le caoutchouc ayant une dureté de caoutchouc dans la plage de 40° à 90° conformément à la norme JIS A, et provoquant une déformation permanente par compression non supérieure à 20 % conformément à la norme JIS K 6301.

7. Appareil électrophotographique comportant un élément photosensible (11), un élément (12, 13) de formation d'une image latente, un moyen de développement (14) destiné à développer une image latente formée, un moyen de report (15) destiné à reporter une image développée sur un support de réception de report, et une lame de nettoyage, ladite lame (16) de nettoyage étant constituée de caoutchouc siliconé, ledit caoutchouc siliconé contenant une charge ayant un diamètre de particules non supérieur à 1 µm et ne contenant pas plus de 5 % en poids d'un constituant du type organosiloxane à faible viscosité, le caoutchouc ayant une dureté de caoutchouc dans la plage de 40° à 90° conformément à la norme JIS

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A, et provoquant une déformation permanente par compression non supérieure à 20 % conformément à la norme JIS K 6301.

8. Appareil de télécopie comportant un appareil électrophotographique et des moyens de réception (21, 25) destinés à recevoir une information d'image d'un terminal éloigné, ledit appareil électrophotographique comportant un élément photosensible (11), un élément (12, 13) de formation d'une image latente, un moyen de développement (14) destiné à développer une image latente formée, un moyen de report (15) destiné à reporter une image développée sur un support de réception de report, et une lame (16) de nettoyage, ladite lame de nettoyage étant constituée de caoutchouc siliconé, ledit caoutchouc siliconé contenant une charge ayant un diamètre de particules non supérieur à 1 µm et ne contenant pas plus de 5 % en poids d'un constituant du type organosiloxane à faible viscosité, le caoutchouc ayant une dureté de caoutchouc dans la plage de 40° à 90° conformément à la norme JIS A, et provoquant une déformation permanente par compression non supérieure à 20 % conformément à la norme JIS K 6301.