

[54] **CLEANING DEVICE**

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[73] Assignee: **Canon Kabushiki Kaisha**, Tokyo, Japan

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July 20, 1973 Japan..... 48-82031

[52] **U.S. Cl.**..... 355/15; 15/256.51

[51] **Int. Cl.²**..... G03G 21/00

[58] **Field of Search**..... 355/15, 17, 30 D; 117/17.5; 15/256.51; 118/637

[56] **References Cited**

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Primary Examiner—Richard L. Moses

Attorney, Agent, or Firm—Fitzpatrick, Cella, Harper & Scinto

[57] **ABSTRACT**

An improved blade type cleaning device for electro-photographic copying machines, wherein, in addition to a resilient cleaning blade having an edge in contact under pressure with the surface of an image holding body, there is provided a guide plate having one of its edges confronting the edge of the cleaning blade, the edge being so adjustable as to be brought to its confronting position with respect to the edge of the cleaning blade when it is set at the cleaning position.

9 Claims, 10 Drawing Figures

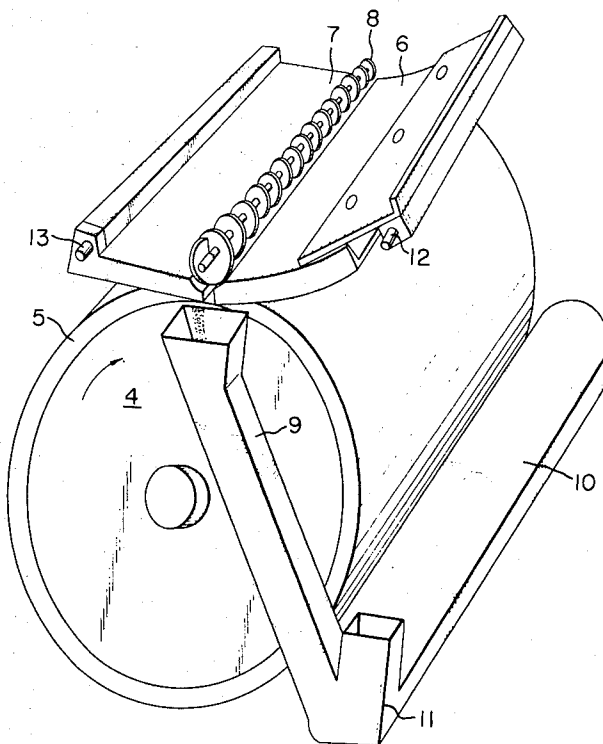
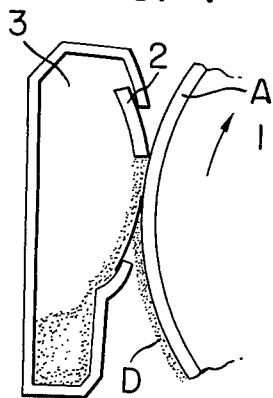
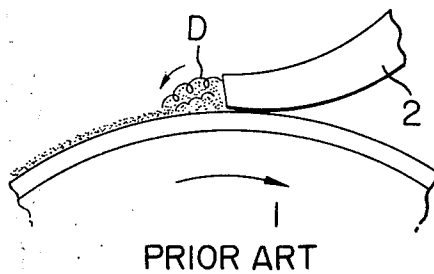


FIG. 1



PRIOR ART

FIG. 2



PRIOR ART

FIG. 3

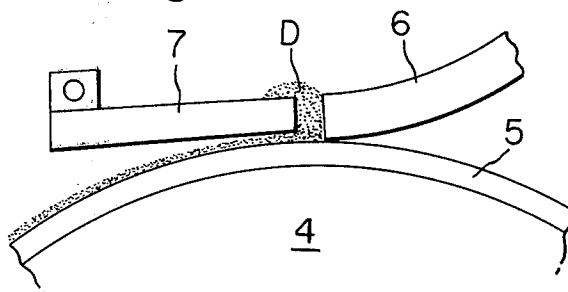


FIG. 5

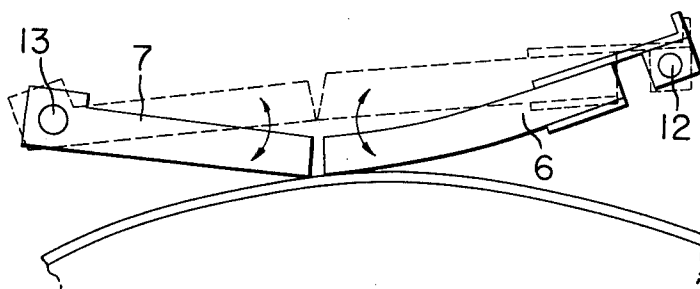


FIG. 7

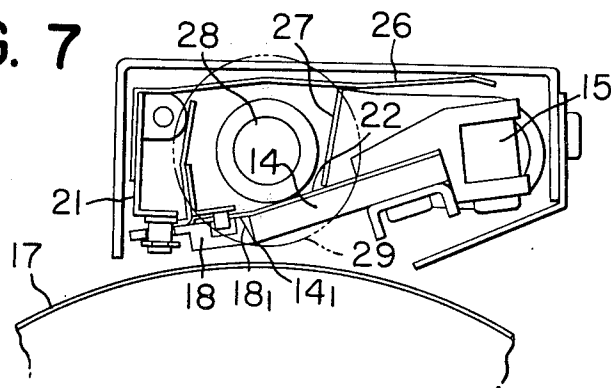


FIG. 4

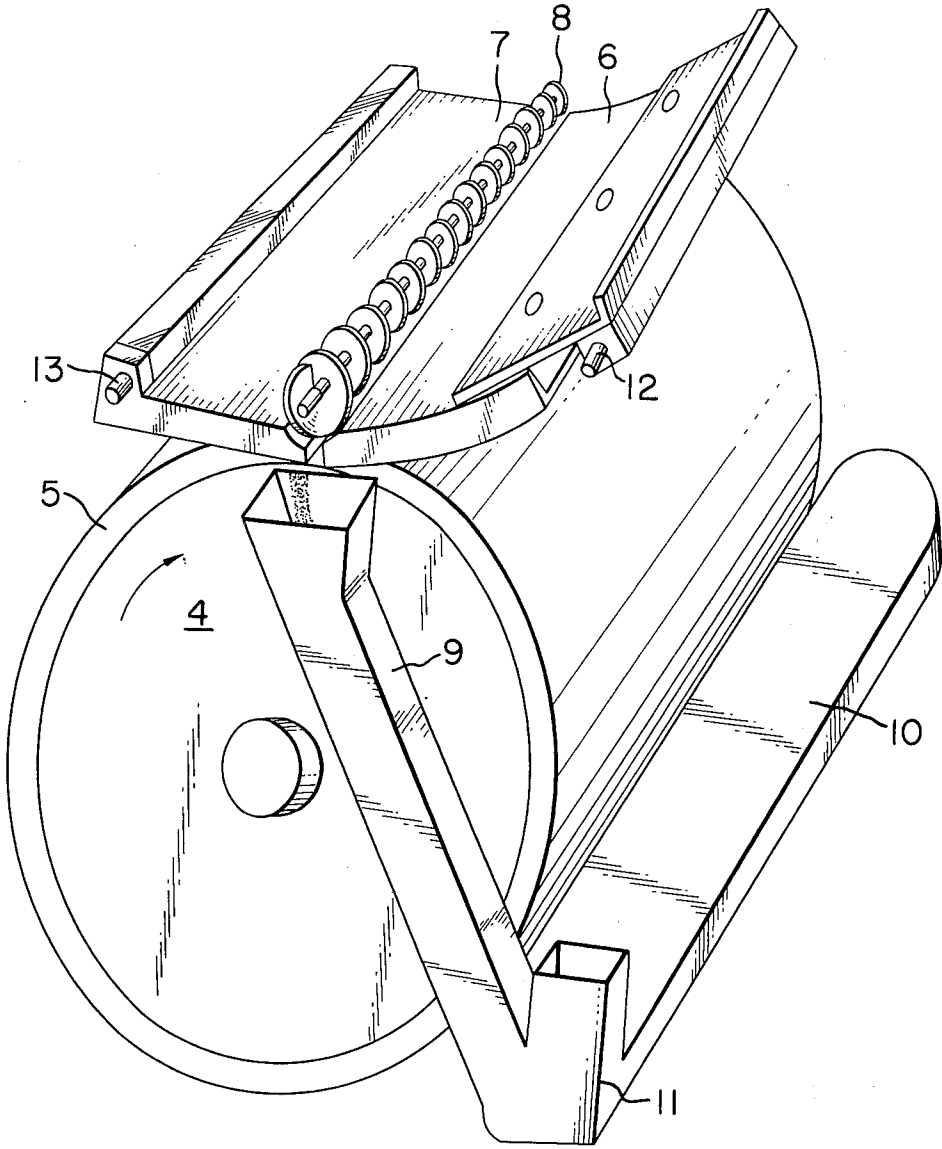


FIG. 6

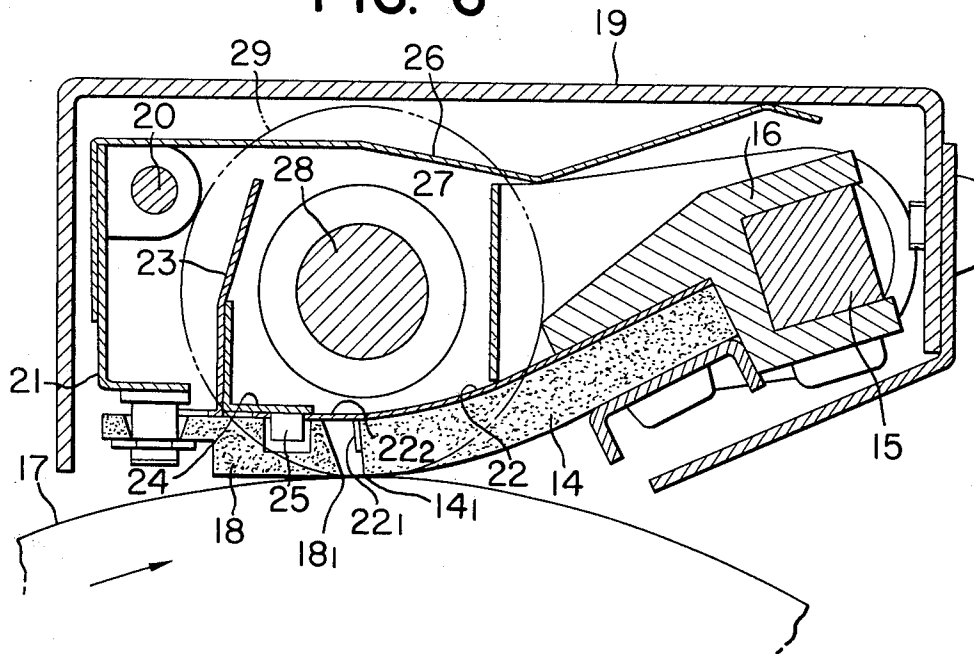


FIG. 8

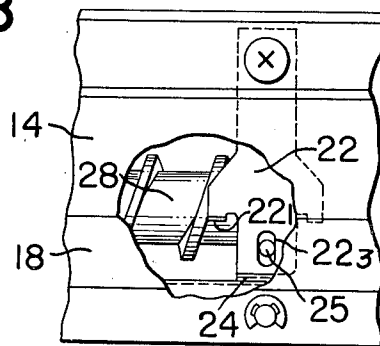


FIG. 10

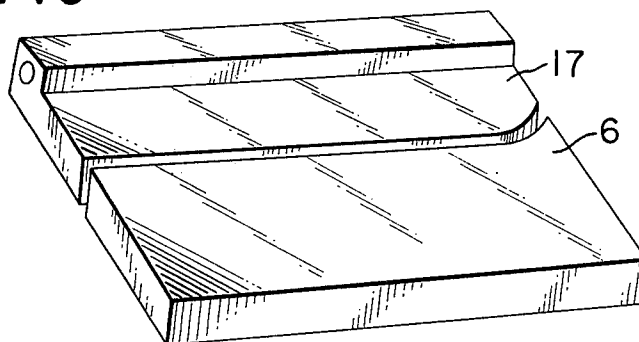
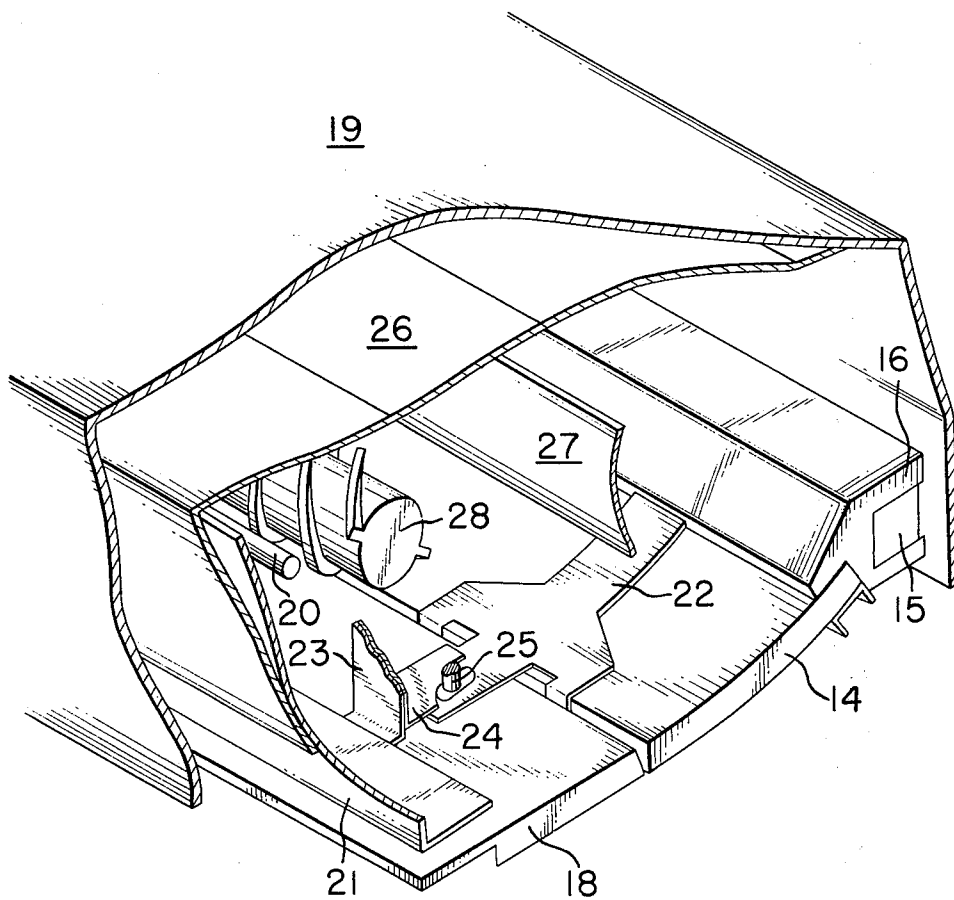


FIG. 9



CLEANING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a cleaning device for use in an electrophotographic copying machine, and, more particularly, it is concerned with a device that is capable of sufficiently cleaning the developing agent remaining on an image holding body by means of a resilient blade.

2. Description of Prior Art

As is well known, a blade is used in ordinary cases, to remove the residual toner on the surface of a photosensitive member by scraping it with the edge of the blade, which is made of wear-resistant rubber material. Since the cleaning device used for this method of cleaning is simple in construction, and can be made compact, it is highly useful as the cleaning device for electrophotographic copying machines. Particularly, this blade cleaning device exhibits satisfactory cleaning effects with a photosensitive member of a copying machine having a flat and smooth surface coated with a substance such as, for example, selenium, Mylar (a trademark for a polyester film produced by E. I. du Pont de Nemour & Co.), and so forth.

One example of the heretofore known blade cleaning device of the above-described type is one wherein the blade cleaning device is disposed on one side of a photosensitive drum with the edge of the blade being directed downward against the rotational direction of the drum. With rotation of the drum in a predetermined direction, the developing agent remaining on the surface of the photosensitive drum is scraped off by the cleaning blade and falls into a receptacle by its own weight. However, when the cleaning device can not be so disposed because of the layout of the copying machine, as a whole, for example agent after being removed from the body surface does not fall into the receptacle by its own weight, but stays at the blade edge with consequent lowering of the cleaning efficiency. Moreover, in the maintenance, etc. of the copying machine where the photosensitive drum and the cleaning device are dismantled, the developing agent which remains at the blade edge scatters around and sticks on other parts of the copying machine to possibly bring about very undesirable results. To avoid such undesirable consequences, it is mandatory that the position of the cleaning blade be limited to the lateral side of the photosensitive drum.

SUMMARY OF THE INVENTION

It is, therefore an object of the present invention to provide a cleaning device for electrophotographic copying machines, the fixing position of which is arbitrarily selectable with respect to the photosensitive member.

It is another object of the present invention to provide a cleaning device which makes it possible to reduce the quantity of residual developing agent at the cleaning location and minimize the scattering thereof to other parts of the copying machine at the time of overhaul, etc.

It is still another object of the present invention to provide a cleaning device which is capable of effectively recovering the developing agent for re-use.

According to the present invention, there is provided a cleaning device for electrophotographic copying ma-

chines which comprises an image holding body, a resilient cleaning blade having an edge in contact under pressure with the surface of the image holding body to scrape off developing agent remaining thereon, and a guide plate disposed on the surface of the image holding body having one of its edges confronting the edge of the cleaning blade, the edge of the guide plate being so adjustable as to be brought to its confronting position against the edge of the cleaning blade at least at the time when cleaning action is being carried out by the cleaning blade.

The resilient cleaning blade and the guide plate of the cleaning device are each mounted in a pivotally rotatable manner, and each of them is provided with a pressure applying means to hold it in contact with the surface of the image holding body under the required pressure.

The cleaning device is also provided with a conveying means to convey the developing agent as it is being removed from the surface of a image holding body to the lateral side. The conveying means is disposed at a position between the confronting edges of the cleaning blade and the guide plate.

The side of the edge of the cleaning blade is given a curved projection at least at one lateral end part thereof, and the guide plate also has a corresponding curvature of the side of the edge confronting the curvature of its cleaning blade at the corresponding lateral end.

The cleaning device is further provided with a connecting member connecting the cleaning blade and the guide plate, the connecting member causing the blade edge to constantly confront against the guide plate edge, and maintains them in a movable manner only in their mutually opposing directions.

The connecting member for the cleaning blade and the guide plate is made of a resilient material so that the blade edge and the guide plate edge connected by the connecting member may contact each other when pressure is imparted by the abovementioned pressure applying means, and upon release of said pressure applying means the resiliency restores the blade edge to its position in contact under pressure with said surface.

The conveying means is moveable with respect to the edges of the cleaning blade and the guide when the cleaning blade and the guide are moved.

The foregoing objects and detailed construction and operations of the device according to the present invention will become more understandable from the following detailed description when read in conjunction with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are respectively fragmentary side elevational views of the conventional blade type cleaning device;

FIG. 3 is a fragmentary schematic side elevational view of the blade type cleaning device according to the present invention;

FIG. 4 is a perspective view of the cleaning device according to the present invention disposed on the peripheral surface part of a photosensitive drum;

FIG. 5 is a side elevational view of the main part of the blade cleaning device according to the present invention;

FIGS. 6 to 9, respectively, explain the actual construction of the cleaning device according to the present invention, in which

FIG. 6 is a cross-sectional view of the inventive device when it is ready for cleaning,

FIG. 7 is a cross-sectional view of the same device in its non-cleaning state,

FIG. 8 is a fragmentary bottom plan view of the cleaning device, and

FIG. 9 is a fragmentary perspective view of the cleaning device with portions removed to show the connection between the blade and the guide plate; and

FIG. 10 is a perspective view showing one example of the shape of the cleaning blade and the confronting guide plate.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring first to FIGS. 1 and 2, which show a conventional cleaning device of the blade type, the blade cleaner is disposed on the lateral side of a photosensitive drum. When the drum 1 having a photosensitive member A on its surface rotates in the direction of the arrow, residual developing agent D on the surface of the photosensitive member A is scraped off by the cleaning blade 2, and the thus removed developing agent falls into a receptacle 3 by its own weight and accumulates therein.

In FIG. 2, the same cleaning device is shown mounted on the top of the photosensitive drum 1, for the convenience of the layout of the copying machine. In this position of the cleaning device, however, the developing agent after its removal does not properly fall into the receptacle 3 by its own weight, but stays at the blade with the consequence that the cleaning efficiency of the cleaning device is lowered. From the standpoint of maintenance of the machine, when the photosensitive drum and the cleaning device are dismantled for overhauling, very undesirable results are apt to occur, such as, for example, scattering of the developing agent remaining on the blade around the other component parts of the machine where it accumulates.

In contrast to this, the blade cleaner according to the present invention, when adapted to a drum type photosensitive member is as shown in FIG. 3, in which a cleaning blade 6 has an edge in contact under pressure with the surface of a photosensitive member 5, provided on the drum 4. In contiguity to the edge of this cleaning blade 6, there is provided a guide plate 7 with its edge opposed to that of the cleaning blade 6. By the provision of this guide plate 7, the particulate developing agent, as it is being scraped off the surface of the photosensitive drum 4, is pushed upward in the gap between the confronting edges of the cleaning blade 6 and the guide plate 7. It goes without saying that this so removed developing powder is taken away from the guide plate by an appropriate means. In the above-described construction, the cleaning blade 6 is made of a material having sufficient elasticity such as, for example, urethane rubber, etc. so as to attain satisfactory contact under pressure with the drum surface. On the other hand, as the guide plate 7 also plays a role of presshardening the toner in advance of the blade cleaning, it is preferably made of a material having appropriate rigidity as well as friction-resistant and autistatic properties. The guide plate 7 further serves to prevent the toner removed by the blade 6 from back-flowing,

and it is necessary that it be made of such a structure that it is capable of maintaining a gap between the blade edge and the guide plate edge by an appropriate pressure. Experiments conducted by the present inventors have revealed that a guide plate made of "Delrin" (a trademark for polyacetal of E. I. du Pont de Nemour & Co.), for example, serves for this practical purpose even by its own weight. More favorable result can, of course, be obtained by additionally providing a pressure adjusting mechanism.

FIG. 4 shows an example of adapting the cleaning device of the present invention to a photosensitive drum, in which a leading screw 8, to convey the developing agent removed from the drum surface, is provided above the gap between the blade 6 and the guide plate 7 so as to convey the removed toner to the lateral side of the drum. The thus conveyed toner, which has been removed, is introduced to the receptacle for the developing agent through the duct 9 connected to the development device 10. On the other hand, the blade 6 and the guide plate 7 are fitted to the side of the body of the copying machine in a manner so that they are pivotally rotatable on their respective shafts 12 and 13.

FIG. 5 indicates the mutual pivotal movements of the blade 6 and the guide plate 7. As mentioned above, the blade 6 is pivotally rotatable on the axis 12, and the guide plate 7 is pivotally rotatable on the axis 13. The blade 6 is in contact under pressure with the surface of the photosensitive member by means of a spring, etc. (not shown), whereby it is warped. This state is shown in solid line in FIG. 5, wherein a gap is formed between the edges of the blade 6 and the guide plate 7. By removing this pressure force, or by any appropriate expedient, the edge of the cleaning blade 6 is caused to contact or brought adjacent to the edge of the guide plate 7. In this state, the cleaning blade 6 and the guide plate 7 move upwardly, whereby the developing agent at the edge portions also moves upwardly along with the blade, without remaining on the surface of the photosensitive member. In the cleaning device constructed according to the present invention, contamination of the photosensitive body surface and the surrounding parts of the copying machine, at the time of maintenance, can be prevented.

For the realization of the foregoing functions, in practice, several problems still exist. That is, the first of such problems is the requirement for constantly maintaining the gap formed between the edge of the cleaning blade and the edge of the guide plate. If this gap becomes non-existent, the abovementioned function can no longer be achieved. To ensure such a gap between the edges of the blade and the guide plate, any fluctuation in the size of the replacement blade should be taken into consideration. For this purpose, a spacer is provided at the end parts of the blade edge and the guide plate edge, which do not participate in the cleaning, so that the guide plate may be pressed against the cleaning blade through the spacer. The mechanism, however, is not sufficient to solve the other problems to be described hereinafter.

The second problem is the requirement for the guide plate to be in contact with the photosensitive drum prior to the separation of the cleaning blade from the drum, when the cleaning blade is to be relieved from operative state of drum surface cleaning. In the absence of this action, the developing agent remains on the drum surface or is spilled, whereby it may be

splashed or scattered around when the photosensitive drum is being mounted or dismantled.

The third problem is that, even after the cleaning blade separates from the photosensitive drum and moves upward, the guide plate should follow the movement of the cleaning blade to maintain the state of contact therewith. Once the cleaning blade and the guide plate separate from each other, the developing agent, which has so far been brought upwardly by the edges of the blade and the guide plate when they are in contact falls and scatters on all four sides. Such a problem is difficult to be solved by only pressing the guide plate to the cleaning blade.

The fourth and last problem is that, when the cleaning blade, which has separated from the photosensitive drum surface and moved upward as mentioned above, is to be repositioned on the drum surface, it must be smoothly returned to its initial state.

With a view to solving these problems most favorably, the actual construction of the cleaning device according to the present invention as shown in FIGS. 6 and 7 is proposed, wherein FIG. 6 is a cross-sectional view of the actual construction of the cleaning device according to the present invention when it is cleaning the drum surface, and FIG. 7 is the same cleaning device in its non-cleaning state, wherein the cleaning blade and the guide plate are separated from the photosensitive drum, and moved upward.

In FIG. 6, the cleaning blade 14 is held at one end to a fitting member 16 which, in turn, is fixed on a shaft 15. The other end, i.e., the cleaning edge, of the blade 14 is brought into contact under pressure with the cylindrical photosensitive body 17, which rotates in a clock-wise direction by causing the shaft 15 to turn in a counter-clockwise direction, and then is locked in its turned position. The cleaning of the photosensitive member 17 is carried out by the sharp corner 14₁ of the blade edge 14.

The guide plate 18 is mounted in a freely swingable manner at the tip end of an arm 21 which hangs from a shaft 20 fixed on a frame 19. On the upper surface of the blade 14, there is fitted a plate spring 22, which is positioned by fixing its bent portion 22₁ at the cleaning edge of the blade 14. The extended part 22₂ of the plate spring 22 beyond its bent portion 22₁ is inserted between the guide plate 18 and an arm 24 extending toward the edge 18₁ of the guide plate 18 from a partition plate 23 fixed substantially upright on the top surface of the guide plate 18. This plate spring 22 acts to press the edge portion 18₁ of the guide plate 18 on the photosensitive drum 17 with an appropriate spring force upon setting of the cleaning blade 14, on which it is fitted, at the required setting position. The tip end part of this plate spring 22 is further provided with an elongated hole 22₃, into which a pin 25 fitted on the lower surface of the arm 24 is inserted, as will be more clearly understood from FIG. 8.

The L-shaped arm 21, which hangs from the shaft 20, has mounted thereon another plate spring 26, by the action of which it receives a moment in the clockwise direction around the shaft 20. Accordingly, the guide plate 18 is subjected to a force which tends to separate it from the blade 14, whereby it is positioned so that the pin 25 engages the end of the elongated hole 22₃ of the plate spring 22 farthest from the cleaning blade 14. As mentioned above, the relative position between the plate spring 22 and the edge part 14₁ of the cleaning

blade is such that they fit together at certain definite positions irrespective of the size of the cleaning blade 14, on account of which the interval between the edge part 14₁ of the blade and the edge part 18₁ of the guide plate is constantly maintained at a predetermined value. From a practical standpoint, the optimum range of the gap is from 0.5 to 5 mm.

The developing agent which has been scraped off the surface of the photosensitive drum by the edge part 14₁ of the cleaning blade is pushed upward by the edges of the blade and the guide plate which are in engagement, and then conveyed sidewise by the leading screw 28 to the receptacle 11 for the developing device, as shown in FIG. 4. This lateral transfer of the developing agent takes place at a position between the partition plate 23 fixed on the upper surface of the guide plate 18 and another partition plate 27 which is fitted around the shaft 15 in a freely rotatable manner and placed on the upper surface of the cleaning blade 14 by its own weight. This leading screw 18 is in contact with the photosensitive drum 17 by means of rolls 29 provided at both ends of the screw shaft. It rests on the drum under its own weight or under an appropriate pressure imparted thereto, and rotates in accordance with the rotation of the drum 17.

Next, for in order the cleaning blade 14 to be separated from the photosensitive drum 17 and to move upward as shown in FIG. 7, the shaft 15 is rotated in a clockwise direction, whereupon the blade is relieved from its bent state, and is restored to its original flat shape. In connection with this restitution, the partition plate 27 placed on the blade 14 is pushed upward, which, in turn, pushes up the plate spring 26 extending from the shaft 20. This movement of the plate spring 26 by the partition plate 27 causes the arm 21 to be subjected to a moment in an anti-clockwise direction in contrast to that effected at the time of cleaning, whereby the edge 18₁ of the guide plate 18 is pushed toward and brought into contact under pressure with the cleaning blade 14 so that the edge 14₁ of the blade 14 can scoop up the residual developing agent from the photosensitive drum. At this time, there still remains a downward spring force, by the plate spring 22, with the consequence that the edge part 18₁ of the guide plate does not separate from the drum surface 17. When the blade 14 leaves a drum surface 17 and further rotates in the clockwise direction, the plate spring 22 then raises the arm 24, and the edges of both the cleaning blade and the guide plate are raised together without discrepancy therebetween. Moreover, in this case, the plate spring 26 is further pushed up to increase the contacting force of the guide plate against the cleaning blade 14, and hence both edges in no way separate from each other. Also, the raising of the cleaning blade 14 accompanies the pushing-up of the leading screw 18, whereby the rollers 29 at both ends thereof separate from the drum surface 17. In this state, mounting and dismantling of the drum 17 and the cleaning device as a whole, can be done freely without scattering the developing agent, whatsoever. Incidentally, FIG. 8 is a fragmentary bottom plan view of the present device, which is maintained in the above-described state, as seen from the side of the photosensitive drum, in and particular, at a position in the vicinity of the plate spring 22.

Re-setting of the cleaning blade 14 on the photosensitive drum surface can be done in opposite procedure

to that employed at the time of releasing. That is to say, after the edge part 14₁ of the cleaning blade contacts the drum surface 17, the edge part of the guide plate 18 separates from the edge part 14₁ of the blade 14, and hence no scattering of the developing agent takes place at the time of resetting.

FIG. 9 is a perspective view of the afore-described cleaning device according to the present invention, from which the positional relationships between the cleaning blade 14, the guide plate 18, the plate springs 22 and 26, the partition plate 23 and 27, arms 21 and 24, and the leading screw 28, can be very clearly seen.

FIG. 10 indicates one example of the edge shape of the cleaning blade and the guide plate. As seen from this embodiment shape, it is highly effective to cause one side of the cleaning blade to jut out to prevent the toner, in its transfer from one end to the other of the photosensitive drum, from remaining on the drum or falling outside the drum. As is shown in this figure, the provision of a certain curvature with this edge projection is particularly preferable to increase the cleaning efficiency. In order to correspond to this shape of cleaning blade, the edge part of the guide plate may be given a corresponding curvature.

As described above, the cleaning device according to the present invention is capable of removing the developing agent from the photosensitive drum surface without scattering it here and there, and hence the device is highly suitable for clean operation and easy maintenance. In addition, since the device is of such construction that the developing agent, as scraped off, is constantly discharged from the cleaning part, so that its working (or cleaning) efficiency is very high. Further, since the discharge of the developing agent is done by the cooperative movement of the cleaning blade and the guide plate, the setting position of the cleaning device with respect to the photosensitive drum can be chosen freely and arbitrarily, which remarkably contributes to the designing and constructing of the device. Furthermore, the developing agent as removed from the photosensitive surface can be recovered for re-use, so that the cleaning device according to the present invention has highly practical significance.

We claim:

1. A device for cleaning an image holding body for use in an electrophotographic copying machine, which comprises: a resilient cleaning blade having an edge in contact under pressure with the surface of the image holding body to scrape off developing agent remaining thereon; and a guide plate disposed on the surface of the image holding body, the guide plate being so adjustable as to bring one of its edges to a confronting position against the edge of the cleaning blade at the time when cleaning action is being carried out by the cleaning blade.

2. A cleaning device according to claim 1, wherein said resilient cleaning blade and said guide plate are each mounted in a pivotally rotatable manner, and are also provided with pressure applying means for holding them, respectively in contact under pressure with the surface of said image holding body under a required pressure.

3. A cleaning device according to claim 1, further

comprising a conveying means disposed at a position between the confronting edges of the cleaning blade and the guide plate to convey the developing agent as it is being removed from the surface of the image holding body, to a lateral side.

4. A cleaning device according to claim 1, wherein the side of the edge of said cleaning blade has a curved projection at least at one lateral end part thereof, and the guide plate also has a corresponding curvature of the side of the edge confronting the cleaning blade at its corresponding lateral end.

5. A cleaning device according to claim 1, further comprising a connecting member connecting the cleaning blade and the guide plate, said connecting member causing the blade edge to constantly confront against the guide plate edge, and maintains them in a movable manner only in their mutually opposing directions.

6. A cleaning device according to claim 5, wherein said connecting member is made of a resilient material so that said blade edge and said guide plate edge connected by said connecting member contact each other when pressure is imparted by pressure applying means, and upon release of said pressure applying means said resiliency restores said blade edge to its position in contact under pressure with said surface.

7. A cleaning device according to claim 3, wherein said conveying means is moveable with respect to the edges of the cleaning blade and the guide when the cleaning blade and the guide are moved.

8. A device for cleaning an image holding body which is supported by a rotatable drum for circulative use in an electrophotographic copying machine, which comprises:

a resilient cleaning blade having an edge in contact under pressure with the surface of the image holding body near the top portion of said drum to scrape off developing agent remaining thereon; and a guide plate disposed on the surface of the image holding body, the guide plate being so adjustable as to bring one of its edges to a confronting position against the edge of the cleaning blade at the time when cleaning action is being carried out by the cleaning blade.

9. A device for cleaning an image holding body which is supported by a rotatable drum for circulative use in an electrophotographic copying machine, which comprises:

a resilient cleaning blade having an edge in contact under pressure with the surface of the image holding body near the top portion of said drum to scrape off developing agent remaining thereon; a guide plate disposed on the surface of the image holding body, the guide plate being so adjustable as to bring one of its edges to a confronting position against the edge of the cleaning blade at the time when cleaning action is being carried out by the cleaning blade;

a conveying means to convey the developing agent, which has been removed from the surface of the image holding body, to a lateral side; and

a collecting means for collecting the developing agent which has been removed.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,917,398

Dated November 4, 1975

Inventor(s) TORU TAKAHASHI, ET AL.

Page 1 of 3

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the Title Page, the title "CLEANING DEVICE" should read
--A CLEANING DEVICE FOR AN ELECTROPHOTOGRAPHIC
COPYING MACHINE--;

Column 1, the title "CLEANING DEVICE" should read --A CLEANING
DEVICE FOR AN ELECTROPHOTOGRAPHIC COPYING MACHINE--;

Column 1, line 9, "mean" should read --means--;

Column 1, line 25, "pond" should read --Pont--;

Column 1, line 37, "for example agent" should read --for
example, the developing agent,--;

Column 2, line 20, "an image" should read --the image--;

Column 2, line 28, "its cleaning blade" should read --the
cleaning blade--;

Column 2, line 28, "the corresponding" should read --its
corresponding--;

Column 3, line 57, "an appropriate means" should read --any
appropriate means--;

Column 4, line 1, "and" should read --and hence,--;

Column 4, line 55, "of the" should read --of both the--;

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,917,398 Dated November 4, 1975

Inventor(s) TORU TAKAHASHI, ET AL. Page 2 of 3

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, lines 64 and 65, "from operative state" should read --from its operative state--;

Column 5, line 26, "wherein the" should read --wherein both the--;

Column 6, line 20, "18" should read --28--;

Column 6, line 26, "Next, for in order" should read --Next, in order for--;

Column 6, line 36, "and" should read --an--;

Column 6, line 38, "whereby the edge 18," should read --whereby the edge 18₁--;

Column 6, line 53, "in no way" should read --cannot--;

Column 6, line 63, "in and" should read --and in--;

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,917,398 Dated November 4, 1975

Inventor(s) TORU TAKAHASHI, ET AL. page 3 of 3

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 67, "in opposite procedure" should read
--in exactly the opposite procedure--;

Column 7, line 33, "to" should read --is--.

Signed and Sealed this

twenty-fourth Day of February 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks