United States Patent [19]

Hudson

[11] **3,807,853**

[45] **Apr. 30, 1974**

[54] **ELECTROPHOTOGRAPHIC CLEANING APPARATUS**

[75] Inventor: **Frederick W. Hudson,** West Henrietta, N.Y.

[73] Assignee: **Xerox Corporation,** Rochester, N.Y.

[22] Filed: **Aug. 9, 1972**

[21] Appl. No.: **279,156**

[52] **U.S. Cl.** **355/15,** 15/256.52

[51] **Int. Cl.** **G03g 15/22**

[58] **Field of Search** 355/15; 15/1.5, 256.51, 15/256.52

[56] **References Cited**

UNITED STATES PATENTS

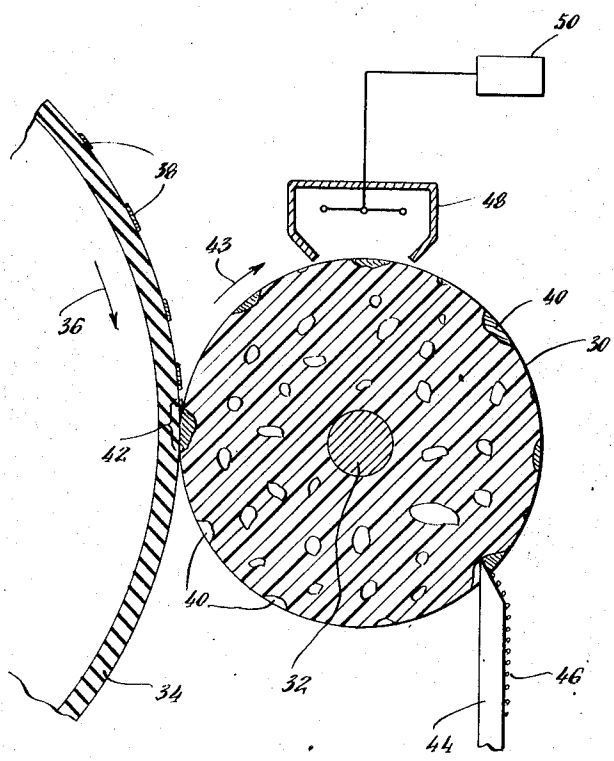
3,728,016	4/1973	Harbour et al.	355/15
3,656,200	4/1972	Riley	15/256.52 X
3,600,081	8/1971	Egnaczak	355/15 X
3,659,302	5/1972	Egnaczak	15/1.5
3,572,923	3/1971	Fisher et al.	355/15
3,438,706	4/1969	Tanaka et al.	355/15 X

Primary Examiner—Fred L. Braun

[57] **ABSTRACT**

An apparatus for cleaning of electrostatographic imaging surfaces, achieved by a cleaning device in the form of a roller and which includes a cellular surfaced material suitable for removal of marking material from an imaging surface. The roller surface is positioned with its long axis transverse to the direction of movement of the imaging surface and transported over an area of sweeping engagement with the imaging surface. The outer surface of the roller has a plurality of open cells which entrap the excess material on the imaging surface during the sweeping engagement thereof. After engagement, the roller is brought into proximity with a removal device for removing marking material from the surface cells. In preferred form, the roller surface is a polyurethane foam which is driven by a suitable drive in sweeping engagement with the imaging surface. An additional roller may be employed to increase the efficiency of cleaning.

15 Claims, 4 Drawing Figures



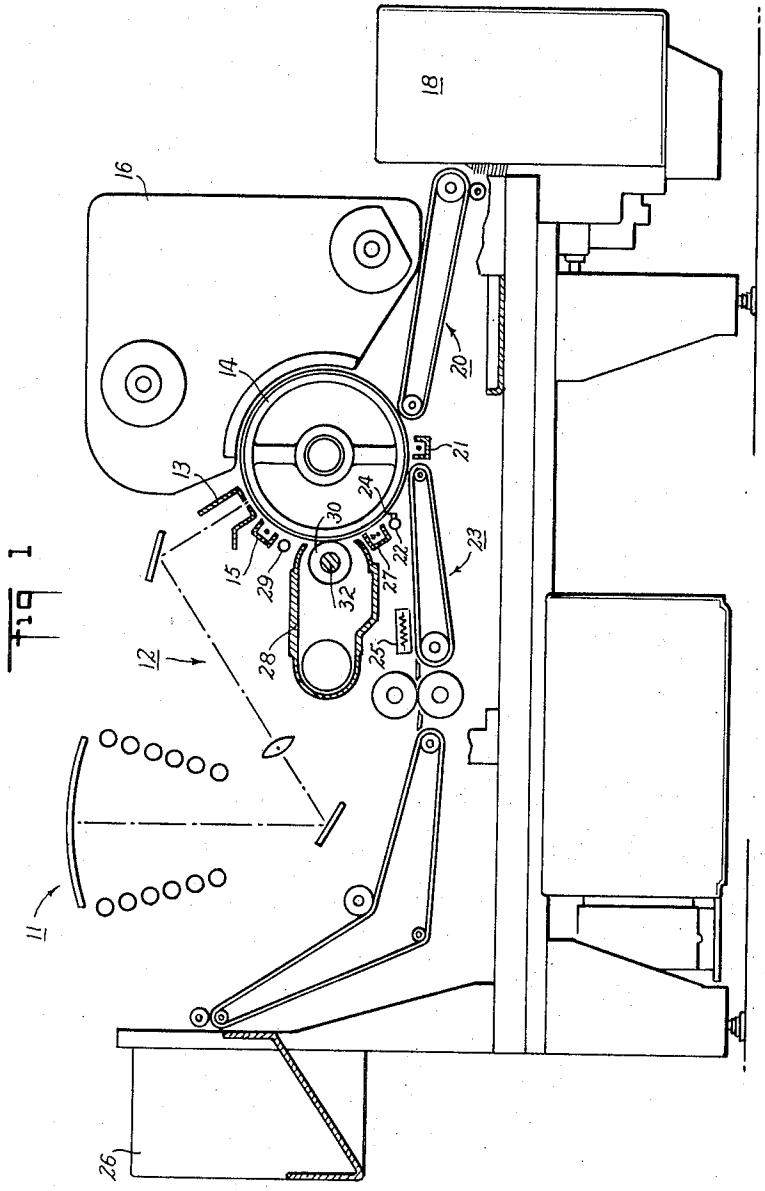


Fig 1

Fig. 2.

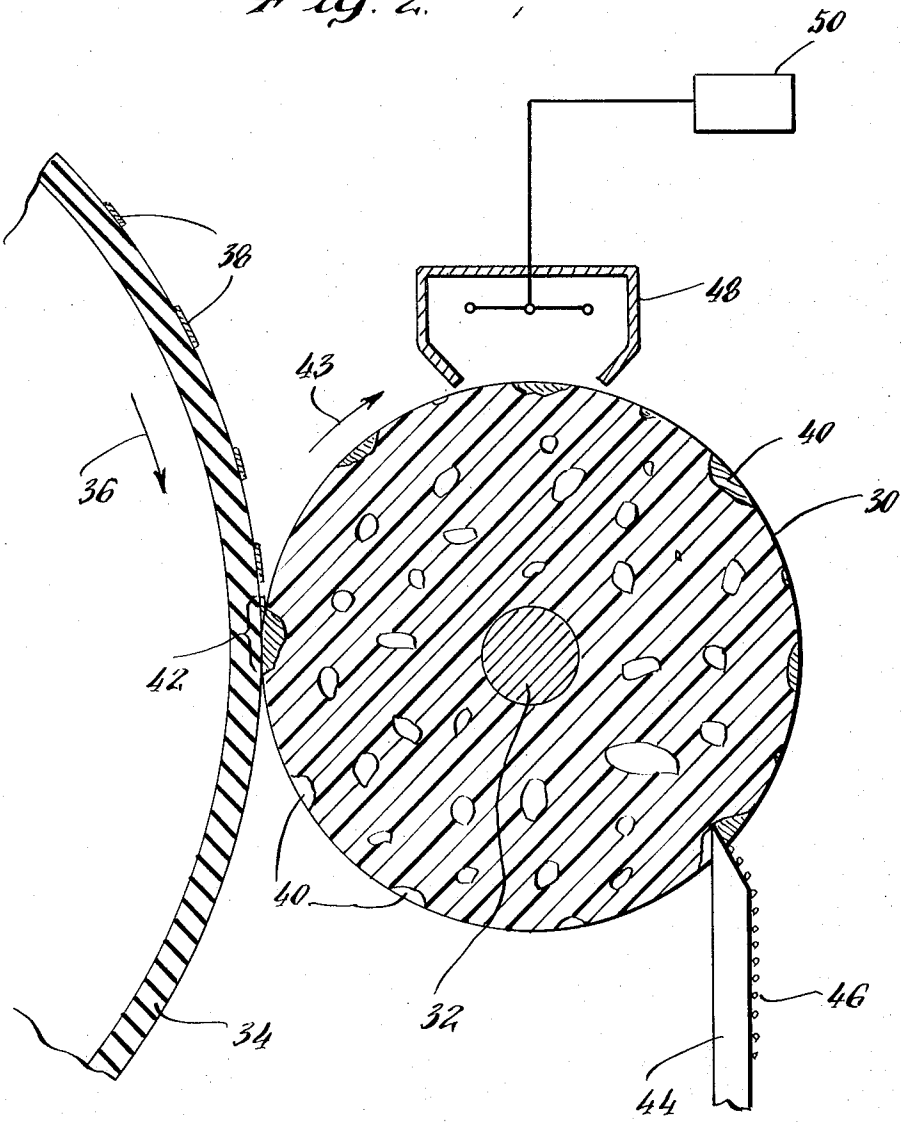


Fig. 3

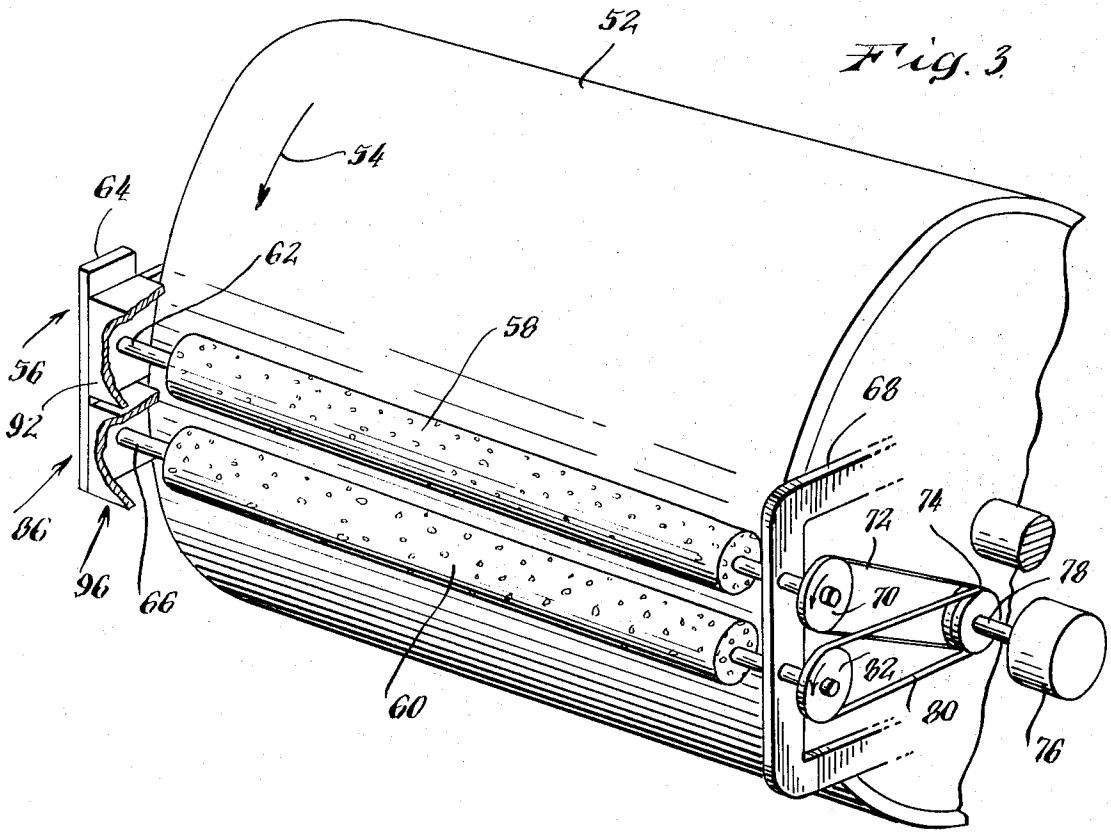
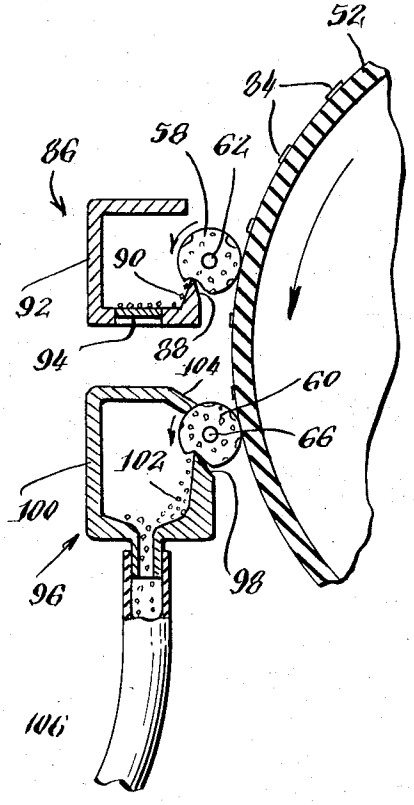

52
54
64
62
58
56
92
68
74
72
78
70
86
82
80
96
66
60
76

Fig. 4


52
84
86
58
62
90
92
94
88
104
60
66
102
100
96
98
106

ELECTROPHOTOGRAPHIC CLEANING APPARATUS

This invention relates to electrostatographic imaging systems and, more particularly, to an improved apparatus for cleaning electrostatographic imaging surfaces.

The formation and development of images on the surface of recording materials by electrostatographic means is well known. One basic process, as taught in U.S. Pat. No. 2,297,691, by C. F. Carlson involved placing a uniform electrostatic charge on an imaging surface such as a photoconductive insulating layer, exposing the layer to a light-and-shadow image to dissipate the charge on the areas of the layer exposed to the light and developing the resulting electrostatic latent image by depositing on the image a finely divided electroscopic material referred to in the art as "toner." The toner is normally attracted to those areas of the layer which retain a charge, thereby forming a toner image corresponding to the electrostatic latent image. This toner image may then be transferred to a support surface such as paper, and the transferred image may subsequently be permanently affixed to the support surface. After transfer, the residual toner remaining on the imaging surface is removed by a cleaning operation and the imaging surface may then be employed for another imaging cycle.

As is well known in recent years, the steadily increasing size of various industries has required an enormous increase in the amount of paper work that must be accomplished, maintained, and made available for wide circulation. In present day commercial automatic copiers/reproduction machines, the electrostatographic imaging surface, which may be in the form of a drum or belt, moves at high rates in timed unison relative to a plurality of processing stations. This rapid movement of the electrostatographic imaging surface has required vast amounts of toner to be used during development.

Associated with the increased amounts of toner is the difficulty in removing the residual toner image remaining on the imaging surface after transfer. In the reproduction process of Carlson as described above, the residual image is tightly retained on the photoconductive layer by a phenomenon that is not fully understood but believed to be caused by an electrical charge and Van der Waals forces that prevents complete transfer of the toner to the support surface, particularly in the image area. The residual toner image is normally removed by cleaning devices such as a "brush" type cleaning apparatus or "web" type cleaning apparatus. A typical brush cleaning apparatus is disclosed in U.S. Pat. No. 2,832,977 to L. E. Walkup et al. and in U.S. Pat. No. 2,911,330 to H. E. Clark. The brush-type cleaning means usually comprises one or more rotating brushes which brush toner from the photoconductive surface into a stream of air which is exhausted through a filtering system. A typical web cleaning device which retains toner is disclosed in U.S. Pat. No. 3,186,838 to W. P. Graff, Jr. et al.

While ordinarily capable of cleaning electrostatographic imaging surfaces, conventional cleaning devices have not been entirely satisfactory. Most of the known cleaning devices usually become less efficient as they become contaminated with toner which cannot be removed necessitating frequent replacement of the cleaning device. As a result, valuable time is lost during

"down time" while a change is being made. A further problem is that cleaning devices employed in current commercial copier/duplicator machines permanently remove residual toner particles from the system. Since toner is an expensive consumable, permanent removal of the residual toner particles from the system during cleaning is undesirable because it adds to the cost of machine operation. Both the web-type and brush cleaning units normally do not return residual toner particles to be reusable as developer after the cleaning operation due to the collection of lint from the web or brush. Furthermore, the cleaning operation can result in generation of heat resulting in physical and chemical changes in the toner. In addition, an elaborate and noisy vacuum and filtering system is necessary to collect the residual toner particles removed by the brush. Moreover, large amounts of toner particles thrown into the air by the rapidly rotating brush cleaner often drift from the brush cleaning housing and form unwanted deposits on critical machine parts.

While the web type cleaner has some advantages it is difficult to align with the surface of the electrostatographic imaging surface and uneven contact between the web and the surface as well as uneven takeup of the web on a takeup roll is often encountered even with complex alignment apparatus. Another problem with the web type cleaner is that pressure contact between cleaning webs and some imaging surfaces must be kept to a minimum to prevent destruction of the imaging surface.

In. U.S. Pat. No. 3,580,673 to F. Y. Yang, there is disclosed another type of cleaning device employing a brush roller contacting the imaging surface and wherein magnetic beads are intermixed with toner particles and subjected to an attractive bias force which aids in dislodging the residual toner image. However, although the use of magnetic beads accomplishes the cleaning function, it is more desirable to effect an efficient cleaning operation without the use of additional particulate material. In U.S. Pat. No. 3,572,923 to D. J. Fisher, opposite biasing is employed to attract particles from a brush roller which contacts the imaging surface to remove residual toner.

Both of the foregoing systems, although improving toner removal by means of electrostatic forces, require a brush roller engaged in frictional contact with the imaging surface.

As reproduction and copying devices become both smaller and more sophisticated, spacing on the imaging surface becomes more critical. It is, therefore, desirable to reduce the spacing occupied by the individual stations along the surface as much as possible. Cleaning devices, such as rotating brushes, contacting webs and the like have heretofore occupied a necessarily large area on the imaging surface as was necessary in order to accomplish their cleaning function effectively. One problem encountered in reducing cleaning spacing is early clogging, a condition resulting from insufficient absorbent or absorbent action to toners resulting from an insufficient capacity cleaning action, such as too small a brush roller, or the like.

It is, therefore, a primary object of this invention to provide a novel apparatus for cleaning electrostatographic imaging surfaces which overcome the above-noted deficiencies.

It is a further object of this invention to reduce toner consumption in automatic electrostatographic imaging machines.

It is another object of the present invention to provide a cleaning apparatus with reduced spacing requirements that will be less subject to clogging.

It is also an object of this invention to utilize cleaning apparatus and reproduction equipment which does not require extensive alignment or adjustment.

It is another object of this invention to remove residual toner for immediate reuse in an electrostatographic imaging machine.

It is a further object of this invention to provide a simple, inexpensive and reusable apparatus for an electrostatographic imaging machine which is more efficient than existing cleaning devices.

It is still a further object of this invention to prevent powder cloud formation as a result of a toner particle dispersion at the cleaning station of an electrostatographic imaging machine.

It is another object of this invention to reduce noise level of an electrostatographic imaging machine.

The foregoing objects of the present invention are achieved by a cleaning means in the form of a roller and which includes a cellular surfaced material suitable for removal of marking material from an imaging surface. The roller surface is positioned with its long axis transverse to the direction of movement of the imaging surface and transported over an area of sweeping engagement with the imaging surface. After engagement, the roller is brought into proximity with a removal means for removing marking material from the surface cells. In preferred form, the roller surface is a polyurethane foam which is driven by a suitable drive means in sweeping engagement with the imaging surface. An additional roller may be employed to increase the efficiency of cleaning.

The foregoing objects and brief description of the present invention as well as other objects and further features thereof will become more apparent from the following more detailed description and appended drawings wherein:

FIG. 1 is a partial schematic and cross-sectional side elevational view of a cleaning apparatus as employed in conjunction with a form of electrostatographic imaging machine;

FIG. 2 is a detail of the cleaning mechanism of FIG. 1;

FIG. 3 is a perspective view of an alternative form of the cleaning mechanism of FIG. 1; and

FIG. 4 shows a detail of FIG. 3.

For a general understanding of the processing system in which the present invention is incorporated, reference is had to FIGS. 1 and 2 wherein like numerals refer to like components in which the various system components are schematically illustrated. In the electrostatographic system shown, a light image of copy to be reproduced is projected onto the charged surface of an electrostatographic plate to form an electrostatic latent image thereon. Thereafter, the latent image is developed with an oppositely charged electroscopic developing material to form a powder image, corresponding to the latent image, on the plate surface. The powder image can then be electrostatically transferred to a web of suitable transfer material in sheet form to which it may be fused by a fusing device, whereby the powder image is caused permanently to adhere to said transfer sheet material.

In the system disclosed herein, documents to be reproduced are placed at the imaging station, generally designated by reference character **11,** which includes a light projecting system, for the purpose of scanning. The illuminated data is projected downwardly by means of a mirror-lens imaging assembly **12** and through a slit aperture assembly **13** and onto the imaging or reproducing surface of an electrostatographic plate in the form of a drum **14.**

The electrostatographic drum **14** includes a cylindrical member mounted in suitable bearings in the frame of the machine and is driven in a clockwise direction as viewed in FIG. **1** by a motor at a constant rate that is proportional to the scan rate whereby the peripheral rate of the drum surface is substantially identical to the rate of movement of the reflected light image. The drum surface comprises a layer of photoconductive material on a grounded conductive backing that is sensitized prior to exposure by means of a corona generating device **15.** Although the present invention is described herein with respect to use of a photoconductive surface, it is equally applicable to instances wherein an electrostatic latent image is formed on an insulating surface as in electrophotography.

The exposure of the drum surface to the light image discharges the photoconductive layer in the areas struck by light, whereby there remains on the drum an electrostatic latent image corresponding to the light image projected. As the drum surface continues its movement, the electrostatic latent image passes through a developing station in which there is positioned a developer apparatus including a housing **16** for developing material. A suitable driving means is used to carry the developing material to the upper part of the developer housing where it is cascaded down over a hopper chute onto the electrostatic latent image on the drum.

As the developing material is cascaded over the electrostatographic drum, toner particles are pulled away from the carrier component of the developing material and deposited on the drum to form powder images, while the partially denuded carrier particles pass off the drum into the developer housing sump.

Positioned next and adjacent to the developing station in a clockwise direction is an image transfer station which includes a sheet feeding mechanism adapted to feed sheets successively to the developed image on the drum at the transfer station. This sheet feeding mechanism, generally designated **18,** includes a sheet source for a plurality of sheets of a suitable transfer material that is typically sheets of paper or the like, a separating roller adapted to feed the top sheet of the stack to feed belt and rollers **20** which direct the sheet material into contact with the rotating drum at a speed preferably slightly in excess of the rate of travel of the surface of the drum in coordination with the appearance of the developed image at the transfer station. In this manner, the sheet material is introduced between the feed rollers and is thereby brought into contact with the rotating drum at the correct time and position to register with the developed image. To effect proper registration of the sheet transfer material with the feed roller and to direct the sheet transfer material into contact with the drum, guides are positioned on opposite sides of the feed rollers.

The transfer of the powder image from the drum surface to the transfer material is effected by means of a corona transfer device **21** that is located at or immediately after the point of contact between the transfer material and the rotating drum. The corona transfer device **21** is substantially similar to the corona discharge device **15** in that it includes an array of one or more corona discharge electrodes that are energized from a suitable high potential source and extend transversely across the drum surface and are substantially enclosed within a shielding member.

In operation, the electrostatic field created by the corona transfer device is effective to tack the transfer material electrostatically to the drum surface, thus causing the transfer material to move synchronously with the drum while in contact therewith. Simultaneously with the tacking action, the electrostatic field is effective to attract a significant portion of the toner particles, forming the powder image, from the drum surface and cause them to adhere electrostatically to the surface of the transfer material.

Immediately subsequent to the image transfer station is positioned a transfer material stripping apparatus or paper pickoff mechanism, generally designated **22,** for removing the transfer material from the drum surface. This device includes a plurality of small diameter, multiple outlet conduits **24** of a manifold that is supplied with pressurized aeriform fluid through the outlet conduits into contact with the surface of the drum slightly in advance of the sheet material to strip the leading edge of the sheet material from the drum surface and to direct it onto a horizontal conveyor **23.** The sheet material is then carried to a fixing device in the form of a fuser assembly **25,** whereby the developed and transferred powder image on the sheet material is permanently fixed thereto.

After fusing, the finished copy is preferably discharged from the apparatus at a suitable point **26** for external collection, in a copy collector positioned at a convenient place for copy removal by the machine operator.

The next and final station in the device is a drum cleaning station having positioned therein a corona precleaning device **27** similar to the corona charging device **15,** to impose an electrostatic charge on the drum and residual powder adherent thereto to more readily permit removal of residual or untransferred toner. To aid in effecting removal of the powder, a drum cleaning device **28,** adapted to remove any powder remaining on the drum surface after transfer, is also provided as is a source of light **29** whereby the photoconductive drum is flooded with light to cause dissipation of any residual electrical charge remaining thereon.

In general, the electrostatic charging of the electrostatographic drum in preparation for the exposure step and the electrostatic charging of the support surface to effect transfer are accomplished by means of corona generating devices whereby electrostatic charge is applied to the respective surfaces in each instance. Although any one of a number of types of corona generating devices may be used, a corona charging device of the type disclosed in the U.S. Pat. No. 2,836,725 to Vyverberg is used for both the corona charging device **15,** the corona transfer device **21,** and the corona precleaning device **27,** each of which is secured to suitable frame elements of the apparatus and connected to suitable power sources.

The present invention utilizes a cleaning device which employs the use of a cellular surfaced material. The cellular surfaced material employed is physically constituted by an expanded structural material of low apparent density, such expanded material being defined as a cellular solid whose volume contains an appreciable fraction of uniformly dispersed voids or cells. Expanded materials may be classified as either the open or closed cell type, the former consisting of a series or plurality of interconnected cells which are capable of absorbing large quantities of fluid, and the latter, or closed cell type, consisting of discrete voids, each void being completely surrounded by a thin envelope of resin. The most common types of expanded materials are phenol-aldehyde and urea-aldehyde resins, polystyrene, polyethylene, polyurethanes, plasticized poly(-vinyl chloride), cellulose acetate, and both natural and synthetic elastomers. In conjunction with the present invention, either the open or closed cell materials can be used. Where the closed cell material is used, the surface cells are themselves each cut open by the formation of the material around the supporting subsurface. The resultant material will thus have surface cells, either in the form of naturally open cells facing the area to be cleaned, or opened cells formed by cutting across closed cells to form the surface of the cleaning roller. In either event, the use of either open or closed cell material result in an open-celled surface which is to be exposed to the surface area to be cleaned. Referring again to FIG. **2,** an expanded material **30,** which may preferably take the form of a polyurethane foam material mounted on a central shaft **32,** is illustrated with a plurality of openings formed by the open cells **40** facing the surface **34** of an area to be cleaned. The imaging surface **34** has a direction of rotation indicated by the arrow **36,** and forms a nip with the roller formed by the cellular material **30.** The nip is such that the cleaning material **30** exhibits a degree of impact relative to the surface **34** sufficient to cause the residual marking material **38** to be wiped into the open celled surface of the material **30.** For this reason, the shaft **32** causes the material **30** to rotate about an axis transverse to the direction of movement of the surface **34,** in a direction resulting in frictional engagement between the open celled structure of the material **30** and the surface **34** to be cleaned. It is not necessary for the material to rotate in an opposite direction to the surface **34** to be cleaned, but a differential surface speed is preferred in order that the cells most efficiently fill with the marking material **38** to be removed from the surface **34.** In operation, those surface cells on the area of the material not yet in contact with the surface **34,** as is shown in the lower hemisphere portion of the material **30,** FIG. **2,** are open without any material therein. As the open surface cells approach the drum surfaces as shown at the region **42,** an open cell will fill with the material derived from the contact between the two surfaces. As the material **30** continues to rotate in the direction indicated by the arrow **43,** the cells now filled with material continue to rotate until these cells reach the pick-off mechanism illustrated in this example as a scraper or doctor blade mechanism **44.** The doctor blade abrades against the material **30** with sufficient force to enter the cellular structure and scrape the material from the cellular structure. The material, indicated generally as **46,**

is dislodged and cascades down the outer surface of the scraping mechanism **44** into a convenient receptacle, not shown, where it can be recycled for further development or disposed of, as will be explained in further detail below. Where the developing material is electoscopic toner as discussed in conjunction with the embodiment as illustrated in FIG. **1**, it has been found that most efficient cleaning operation will occur with a relatively fine celled structure wherein the cells are spaced at approximately 100 per linear inch of the surface of the material **30**. Cellular structures may vary quite considerably from this range, and it is not intended that the foregoing example be limiting in any respect. Coarser cell structures, of the order of 10 per linear inch are also possible, however, it should be noted that since there is abrasive contact between the surface of the material **30** and the surface **34** to be cleaned, care must be taken that the surface **34** does not itself become abraded by the rubbing action of the material **30**. Thus, the material **30** should consist of a relatively soft and relatively non-abrading surface. Since it may be possible, due to the tribo-electric properties of the surface of the material forming the area **34** to be cleaned, that the roll of expanded material **30** acquires a charge as a result of the sweeping contact between the two surface areas, a discharge device such as the corona unit **48** may be provided with a source of potential **50** coupled thereto of magnitude and polarity sufficient to neutralize the charge accumulating on the roller **30**. Corona discharge devices are described in detail in the aforementioned Vyverberg patent.

Referring now to FIG. **3**, an alternative embodiment employing the use of a roller in accordance with the present invention is explained and illustrated in further detail. In the embodiment shown in FIG. **3** an imaging surface **52**, such as a photoreceptive or insulating drum which is to be cleaned is rotated in the direction of the arrow **54** through the cleaning station **56** corresponding to the cleaning station **28** illustrated in the FIG. **1**. In this embodiment, a pair of rollers, each containing expanded materials such as a polyurethane foam of either the open or closed cell variety is shown. The cleaning action occurs at the nip formed between the first foam roller **58** and the second foam roller **60** against the surface **52**. The foam roller **58** is mounted on a shaft **62** positioned transversely to the rotational direction of the surface **52**, and which is journaled for rotation into a frame member **64** which may in turn be mounted to the machine housing, not shown. The second foam roller **60** is mounted on a parallel shaft **66** which is also journaled for rotation into a frame member **64**. The shaft **62** is coupled at its opposite end through a further frame member **68** to a pulley **70** which is in turn driven by a belt **72**. The belt **72** is coupled to a drive pulley **74** which is in turn driven by a motor unit **76** through a shaft **78**. The pulley **74** is also coupled by means of a belt **80** to a further pulley **82** which is in turn coupled through the frame **68** to the other end of the shaft **66** for driving the second roller **60**. Each of the rollers **58** and **60** utilize open celled surfaces and operate to clean the surface of the drum in the manner explained in connection with the embodiment illustrated in FIG. **2**.

As shown in further detail in FIG. **4**, the first roller **58** operates against the surface **52** to remove the major portion of residual developing material such as the electroscopic toner illustrated as element **84** on the surface of the drum **52**. As the drum **52** rotates, the electroscopic toner material **84** passes into the nip formed by the roller **58** and the surface **52**, the sweeping engagement results in material filling the cellular surface of the roller **58**. The roller **58** continues to rotate in the direction indicated by the arrow, therein, and comes into contact with the pick-off mechanism illustrated generally as element **86** and which includes a scraping mechanism **88** such as a doctor blade positioned so as to deformably engage the surface of the roller **58** and dislodge and remove material **90** from the cellular surface in the manner described in connection with FIG. **2**. As the particles **90** fall along the surface of the scraper mechanism it enters the enclosure indicated as a framework **92**. The framework **92** includes a conveyor network **94** which responds to the receipt of the material **90** removed by the scraper mechanism **88** from the roller **58** for conveying the material back to the developing mechanism, thereby recycling the developing material for reuse.

After the drum surface **52** emerges from the nip formed by the roller **58** and the drum surface **52**, it approaches the second nip formed by the roller **60** on the drum surface **52**. The roller **60**, which may have a finer cell structure than the roller **58**, then removes any residual developer material still remaining on the surface of the drum **52** which may not have been removed by the first roller **58**. Roller **60**, rotating in the direction indicated by the arrow, enters a second pick-off mechanism indicated generally as **96** and which may also include a scraper member **98** fixed to the framework **100**. Residual material **102** is removed from the surface of the roller **60** by the negative pressure resulting from vacuum, and also by the scraper **98**. As shown, the material **102** falls within the chamber defined by the framework **100** which in this embodiment is preferably an air sealed closed loop between the scraper **98** and the upper portion of the framework **104**, in order to render the vacuum mechanism coupled to the exit port **106** effective in removing material thus collected. Since a relatively small amount of material will be dislodged and removed by virtue of the roller **60**, relatively lower vacuum pressure, along with reduced noise levels, heat levels, etc. is required to remove the remaining developer. A permanent disposal system for this latter material may be employed in lieu of the recycling system noted in connection with the pick-off mechanism **86**.

It should be noted that vacuum removal can be applied directly to the cellular surface after cleaning of the imaging surface without the need for direct scraping contact. In such case, the strength of the vacuum would determine the degree to which material is removed from the open cells.

Typical conveyor systems for recycling material reclaimed from the surface of a cleaning mechanism is illustrated in the U.S. Pat. No. 3,527,387 to Wilson.

Further details of a reproduction device employing a drum surface is shown in the U.S. Pat. No. 3,301,126 to Osborne et al.

In addition to the rotating drum illustrated, it will be evident from the following description that the present invention may be employed with other forms of reproducing devices, such as the endless loop photoreceptor shown in U.S. Pat. No. 3,432,231 to Gardner. In addition, the present invention may also be used with other forms of development employing marking materials

such as inks instead of the electroscopic toner material as described in conjunction with FIG. 1.

Although the invention has been described with reference to the structures disclosed herein, it should not be confined to the details set forth since it is apparent that various modifications can be made. Thus, for example, additional rollers may be employed at various locations around the surface which it is desired to clean, and other means may be employed for cleaning the surfaces of the rollers after removal of the developing material from the surface to be cleaned. In addition, recycling can be provided at both stations with a two roll embodiment, or neither station may employ recycling. In addition, the rollers need not rotate at the same speed, and may rotate at different relative speeds to take advantage of the various absorbing characteristics of varying surface porocity materials.

Other variations and changes will be obviously apparent to those skilled in the art. It will be understood that the examples given in the embodiment shown are done so for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from the scope and spirit of the invention as disclosed herein.

What is claimed is:

1. A cleaning apparatus for cleaning powder material from an imaging surface, said cleaning apparatus and said imaging surface having relative movement, said cleaning apparatus comprising a cellular-surfaced material having a plurality of open cells exposed along its surface, means for effecting sweeping engagement between said cellular-surfaced material and said imaging surface, said sweeping engagement resulting in removal of said powder material from said imaging surface by trapping said powder material within said open cells, and removal means for removing said powder material from said cellular-surfaced material, said removal means including a scraping means for deformably engaging said cellular-surfaced material and removing said powder material from said open cells.

2. The combination in claim **1** further including electrical means for applying an electrical charge to said cellular-surfaced material to assist said cleaning of said powder material.

3. The combination in claim **1** further including means for neutralizing any electrical charge accumulating on said cellular-surfaced material.

4. A cleaning apparatus for cleaning powder material from an imaging surface, said cleaning apparatus and said imaging surface having relative movement, said cleaning apparatus comprising a cellular-surfaced material having a plurality of open cells exposed along its surface, means for effecting sweeping engagement between said cellular-surfaced material and said imaging surface, said sweeping engagement resulting in removal of said powder material from said imaging surface by trapping said powder material within said open cells, and removal means located adjacent said cellular-surfaced material for removing said powder material from said cellular-surfaced material, said removal means including scraping means for deformably engaging said cellular-surfaced material and removing said powder material from said open cells.

5. A cleaning apparatus for cleaning powder material from an imaging surface, said cleaning apparatus and said imaging surface having relative movement, said cleaning apparatus comprising a cellular surfaced roller means, said cellular surface including a plurality of open cells exposed along the roller outer surface, means for transporting said roller means into sweeping engagement with said imaging surface to form a nip between said cellular surface and said imaging surface, said sweeping engagement resulting in removal of said powder material from said imaging surface by trapping said powder material within said open cells along the outer surface of said roller means, and removal means positioned in proximity with said roller means for removing said powder material from said cellular surface, said removal means including a scraping means deformably engaging said roller means and removing said powder material from said open cells of said outer surface of said roller means.

6. The combination of claim **5** wherein said roller means includes a roller having an expanded structural material surface, said roller having its longitudinal axis transversely positioned with respect to said imaging surface.

7. The combination of claim **5** wherein said cellular surface material is polyurethane foam.

8. The combination of claim **5** wherein said roller means includes first and second rollers, each positioned parallel to one another with their respective longitudinal axis positioned along the width of the imaging surface and transverse to the movement thereof, said first roller having a first removal means associated therewith, and said second roller having a second removal means associated therewith.

9. In combination with an electrostato-graphic imaging device including an electrostatographic imaging surface having relative motion with respect to a charging station for applying a charge to said imaging surface, an imaging station selectively discharging said charged surface and forming an electrostatic latent image, a developing station for forming a powder image with electroscopic toner material, and a transfer station for transferring said powder image to a support surface, a cleaning station for cleaning any residual powder material from said imaging surface, said cleaning station comprising a roller having a central shaft and a cleaning surface material affixed to said shaft, said cleaning surface material comprising an expanded structural material having a plurality of open cells defining the outer surface thereof, said roller positioned with said central shaft transverse to the direction of said relative motion, means for driving said central shaft and rotating said roller and said cleaning surface material into a nip formed between said cleaning surface material and said imaging surface whereby said cleaning material and said imaging surface meet in sweeping engagement, said sweeping engagement resulting in placing said residual powder material into said open cells at said nip, and removal means positioned in proximity with said open celled surface of said roller after said sweeping engagement for removing said residual powder material from said open cells, said removal means including a scraping means deformably engaging said open cells of said cellular surface, for dislodging said powder material.

10. The combination of claim **9** wherein said cellular surface material is polyurethane foam.

11. The combination of claim **9** wherein said expanded structural material is of the open celled type.

12. The combination of claim 9 wherein said expanded structural material is of the closed celled type.

13. The combination of claim 9 wherein said roller is a first roller and further including a second roller, each said roller positioned parallel to one another with their respective longitudinal axis positioned along the width of the imaging surface and transverse to the movement thereof, said first roller having a first removal means associated therewith, and said second roller having a second removal means associated therewith.

14. The combination of claim 13 wherein said first removal means further includes means for conveying said dislodged material for reuse in said developing station.

15. The combination of claim 13 wherein said first removal means includes a means for conveying said dislodged material for reuse in said developing station, and said second removal means includes means for applying negative pressure to the surface of said second roller after said sweeping engagement, said negative pressure dislodging said material from said open cells.

* * * * *