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(54) Electrostatographic toner image producing station

(57) Charging means (28) charge a rotatable endless photoconductive surface (26). Exposure means (30, 32) form an electrostatic latent image on the charged surface. A development station (32) deposits toner onto the electrostatic latent image to form a toner image. Transfer means (34) transfers the toner image from the surface to a substrate (12). A driven circumferentially rotatable cleaning brush (43), in frictional contact with the endless photoconductive surface means (26), removes residual toner from the endless photoconductive surface means. A refurbishing brush (68) is in contact with the surface after the cleaning brush and in advance of the charging means to reduce filming and build up of extraneous matter on the surface. The long term appearance of marks on the printed copies derived from lateral scratches in the photoconductive surface are reduced while enabling the printer to continue in its operational mode.

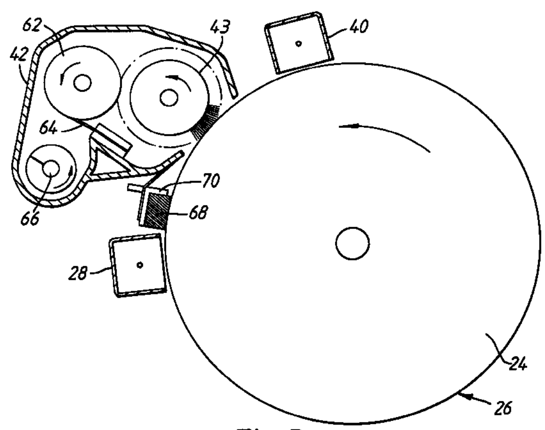

Fig.3

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Description

Field of the invention

The present invention relates to an electrostatographic toner image producing station for use with a printer for forming an image onto a substrate, such as paper.

Background of the invention

Electrostatographic printing operates according to the principles and embodiments of non-impact printing as described, eg, in "Principles of Non-Impact Printing" by Jerome L Johnson (1986) - Palatino Press - Irvine CA, 92715 USA).

Electrostatographic printing includes electrographic printing in which an electrostatic charge is deposited image-wise on a dielectric recording member (imaging member) as well as electrophotographic printing in which an overall electrostatically charged photoconductive dielectric recording member is image-wise exposed to conductivity increasing radiation producing thereby a "direct" or "reversal" toner-developable charge pattern on said recording member. "Direct" development is a positive-positive development, and is particularly useful for reproducing pictures and text. "Reversal" development is of interest in or when from a negative original a positive reproduction has to be made or vice-versa, or when the exposure derives from an image in digital electrical signal form, wherein the electrical signals modulate a laser beam or the light output of light-emitting diodes (LEDs). It is advantageous with respect to a reduced load of the electric signal modulated light source (laser or LEDs) to record graphic information (eg printed text) in such a way that the light information corresponds with the graphic characters so that by "reversal" development in the exposed area of a photoconductive recording layer, toner can be deposited to produce a positive reproduction of the electronically stored original. In high speed electrostatographic printing the exposure derives practically always from electronically stored, ie computer stored information.

As used herein, the term "electrostatographic" also includes the direct image-wise application of electrostatic charges on an insulating support, for example by ionography.

Electrostatographic printers for forming images on a substrate are well known. Such printers may comprise a toner image producing electrostatographic station having rotatable endless photoconductive surface, such as the surface of a drum or belt onto which a toner image can be formed. In multi-colour printers, a number of such image producing stations may be provided. The or each image producing station further comprises means for charging the photoconductive surface. As the surface rotates, it passes an exposure device for forming an electrostatic latent image on the charged surface. A development station then deposits toner onto the electrostatic latent image to form a toner image. The toner image is then transferred from the photoconductive surface to the substrate, which for example is paper in sheet or web form. Following the transfer, the surface passes a cleaning unit where excess toner is removed from the photoconductive surface. The surface is then ready for a further cycle. If the residual toner is not removed, it may be transferred to the substrate in a subsequent cycle, producing the effect of "ghost" images.

In many systems, cleaning is achieved by scraper blades or aggressive driven circumferentially rotatable cleaning brushes. While such devices can be very effective in cleaning, the lifetime of the photoconductive surface is reduced, especially if delicate or fragile photoconductive surfaces are used, such as organic photoconductors.

Less aggressive cleaning devices may be used that combine mechanical forces with electrostatic attraction in order to remove residual toner. A particular construction of such a cleaning unit is described in United States patent US 3572923 (Xerox Corporation). In the construction described therein, the recording surface is wiped with an electrically non-conductive circumferentially rotating brush to which an electrostatic charge, opposite to that on the toner particles, has been applied.

In a similar construction described in Xerox Disclosure Journal Volume 8 Number 3 (May/June 1983), the cleaning brush is comprised of electrically conductive fibres.

European patent specification EP-A-0512362 (Mita Industrial Co. Ltd.) describes a cleaning unit in which two rotatable fur brushes are provided, the tips of the brushes being in contact with a photoreceptor drum, the brushes being electrostatically charges to opposite potentials, to aid in the removal of toner particles of opposite potentials. An AC corona discharger is positioned in advance of the cleaning unit to decrease the charge on the residual toner. The fur brushes are rotated at different speeds.

While these and other cleaning devices used in the art have been generally successful in removing residual toner, and thereby result in extended lifetimes of the photoconductor, we have found that after substantial periods of time, say after 10,000 copies have been printed, we have found that these cleaning methods result in the build up of extraneous matter on the photoconductor surface. One particular form of such build up is the formation of laterally extending scratch marks on the printed copies. The orientation of these scratch marks indicates that they cannot be derived from the operation of the cleaning brush. If the rotating cleaning brush were damaging the photoconductive surface, longitudinal rather than lateral scratch marks might appear on the printed copies. The observed lateral scratch marks are initially barely visible, and therefore not a major problem for the production of medium quality copies of, for example, text. However, in high quality work, especially where the images include pictures or other elements having large areas of print, these scratch marks represent a problem.

Another form of build up of extraneous matter on the photoconductive surface, is the problem of "filming", where after repeated use certain areas of the photoconductive surface pick up less toner during development, with the result that the printed product shows areas of reduced density. This localised loss of performance may be due to changes in the light sensitivity of the photoconductor surface and/or in its ability to retain toner particles. Filming would be less of a problem if it resulted from a substantially uniform loss of sensitivity over the whole photoconductive surface, but we have found that filming occurs more particularly in the region of scratches or other imperfections in the photoconductive surface. It has been proposed in EP 671672 (Xeikon NV) to periodically refurbish the photoconductive surface by abrasion with a cleaning web passed through the printer in order to reduce the effects of filming. While such refurbishment can also be successful in avoiding the appearance of lateral scratch marks, it can sometimes be inconvenient to stop the printer in order to carry out refurbishment, while stopping the printer can also be expensive in terms of lost operational time, since optimum refurbishment may take up to half an hour in any two day operational period. Refurbishment is also costly in terms of the abrasive material used.

SUMMARY OF THE INVENTION

It is an object of the present invention to reduce or avoid the long-term appearance of lateral scratch marks on the printed copies and to reduce the effects of filming while enabling the printer to continue in its operational mode, without the need to use highly abrasive cleaning devices.

We have discovered that this objective can be achieved by the provision of a refurbishing brush located after the cleaning brush but in advance of the surface charging means.

According to the invention there is provided an electrostatographic toner image producing station for use in an electrostatographic printer, the electrostatographic toner image producing station comprising:

- rotatable endless photoconductive surface means onto which a toner image can be formed;

- charging means for charging the endless photoconductive surface means;

- exposure means for forming an electrostatic latent image on the charged endless photoconductive surface means;

- a development station for depositing toner onto the electrostatic latent image to form a toner image;

- transfer means for transferring the toner image from the rotatable photoconductive surface means to a substrate, and

- a driven circumferentially rotatable cleaning brush in frictional contact with the endless photoconductive surface means, to remove residual toner from the endless photoconductive surface means;

<u>characterised by</u> the provision of a refurbishing brush in contact with the endless photoconductive surface means after the driven rotatable cleaning brush and in advance of the charging means.

The refurbishing brush which characterises the electrostatographic toner image producing station according to the invention has the effect of reducing filming and the build up of extraneous matter on the endless photoconductive surface means.

While not wishing to be bound by theory, we believe that the lateral marks on the printed copies derive from minute scratches in the photoconductive surface, which may be caused by manipulation or touching of the surface during the manufacture thereof and/or during maintenance. It is thought that such scratches may also be caused if there is rubbing of the photoconductive surface by the substrate, for example during maintenance. Initially these scratches have a dimension much less than that of the toner particles (typically about 7 µm) and do not therefore pick up toner particles and consequently are not noticeable in the printed copies. However, after prolonged use other particulate material, referred to herein as extraneous matter, of sub-micron particle size, becomes trapped by these scratches and gradually builds up to such a size that the photoconductive surface becomes locally deformed and thus these scratches result in marks on the printed copies. We believe that after time these sub-micron particles become fused to the photoconductive surface, producing a material which is strongly adhered to the surface and therefore not easily removed by the cleaning brush. While longitudinal (e.g. circumferential) scratches in the photoconductive surface may also pick up extraneous matter, this is more easily removed by the cleaning brush and/or at the development station and does not therefore build up to the point where its effect on the printed product becomes noticeable.

Usually, the rotatable endless surface means (imaging member) comprises a belt or the circumferential surface of a drum, especially a belt or drum which has a photoconductive surface. In the following general description, reference is made to a drum, but it is to be understood that such references are also applicable to endless belts or to any other form of endless surface means.

We have found that good results can be obtained where the refurbishing brush has substantially no degree of movement in the longitudinal direction. In one embodiment of the invention the refurbishing brush is stationary. In this embodiment, the brush may be mounted on a support fixed to a housing part of the cleaning device or a housing part of the charging means. Alternatively, the brush may be carried on a separate removable housing part. The refurbishing brush support may be urged against the surface of the drum by a light pressure. After a given period of time, say after printing 150,000 copies, the brush can be cleaned by use of a vacuum cleaner, or may be removed and replaced.

Alternatively, the refurbishing brush is in the form of a belt which can be driven laterally across the rotatable endless photoconductive surface. The device will usually be provided with a stationary spring loaded support plate for the belt to urge the belt against the drum surface with substantially even pressure. Such a belt may be driven at a relatively slow speed, such as from one tenth to one thousandth of the linear speed of the drum in order to avoid fluidising any particulate material picked up by the brush. A vacuum cleaning device may be applied to the belt at a suitable location.

In a less preferred further embodiment, the refurbishing brush is a rotating brush which rotates slower than the drum, for example at a speed of 1 revolution for every 50,000 copies produced by the printer. Such a slowly rotating brush would have a longer lifetime than an equivalent stationary brush.

In a preferred embodiment of the invention, means are provided, located between the transfer means and the driven rotatable cleaning brush, to pre-charge the residual toner. This pre-charging enables the toner to be more easily removed and makes the final charging by the charging means easier. This feature also ensures that substantially all the residual toner is removed by the driven rotatable cleaning brush, leaving the refurbishing brush to remove extraneous matter.

The photoconductive surface may be formed of an organic photoconductor. Organic photoconductive (OPC) materials with two recording active layers contain a combination of a charge generating layer (CGL) and charge transporting layer (CTL). A detailed description of such OPC materials can be found in the prior art and subject matter described in published European patent applications EP 393787, 573084 and United States patent US 4943502 (all Agfa-Gevaert NV).

Using photoconductors of the organic type, it is most convenient to charge the surface of the drums to a negative polarity and to develop the latent image formed thereon in reversal development mode by the use of a negatively charged toner.

The means for image-wise exposing the charged surface of the drum or belt may comprise an array of image-wise modulated light-emitting diodes or take the form of a scanning laser beam.

The toner will usually be in dry particulate form.

Preferably, the refurbishing brush comprises filaments composed of a material selected from polypropylene, polyamides, polyimides, polyesters and mixtures thereof.

The refurbishing brush may have a filament packing density of between 10,000 and 100,000 filaments/cm^2.

Preferably, the charging means is a corona device. The refurbishing brush is preferably located immediately in advance of the charging means. For this reason it is preferred that the filaments of the refurbishing brush be electrically non-conductive, otherwise the electrical field generated by the charging means might be disturbed in an unpredictable manner. It is also important to mount the refurbishing brush in advance of the charging means, so that any charging of the photoconductive surface caused by friction with the refurbishing brush is cancelled out by the charging of the surface with the charging means.

Preferably, the transfer means is a corona device, such as may spray charged particles having a charge opposite to that of the toner particles. The supply current fed to the corona device is preferably within the range of 1 to 10 μA/cm substrate width, most preferably from 2 to 5 μA/cm substrate width, depending upon the substrate characteristics and will be positioned at a distance of from 3 mm to 10 mm from the path of the substrate.

Preferably, the developing unit comprises a driven rotatable magnetic developing brush in frictional contact with the drum surface, the magnetic developer brush rotating in a direction opposite to the direction of rotation of the driven rotatable cleaning brush. We have found that by arranging for the developing brush and the cleaning brush to rotate in opposite senses, it can be assured that the resultant torque applied by the brushes to the drum surface is at least partly cancelled out. To achieve this in a practical manner, the position of at least one of said brushes relative to the drum surface may be adjustable thereby to adjust the extent of frictional contact between that brush and the drum surface.

In one embodiment of the invention, the substrate is in the form of a web which constitutes a final support for the toner images and is unwound from a roll, image-fixing means being provided for fixing the transferred images on the web. In this embodiment, the printer may further comprise a roll stand for unwinding a roll of web to be printed in the printer, and a web cutter for cutting the printed web into sheets.

Drive means are provided to rotate the drum in synchronism with the movement of the substrate. Thus, a drive motor may be mounted on a shaft of the drum. However, we prefer that the drum is driven by adherent contact with the moving substrate, one or more drive motors being provided for driving the substrate past the image forming station. This arrangement reduces the effect of slippage between the drum surface and the substrate, which can result in image errors, and in the case of multiple station printers, can result in mis-registration of images. This indirect driving of the drum is particularly convenient when the substrate is in the form of a web.

The drive means for the web may comprise one or more drive rollers, preferably at least one drive roller being positioned downstream of the image producing stations and a brake or at least one drive roller being positioned upstream of the image forming stations. The speed of the web through the printer and the tension therein is dependent upon the speed and the torque applied to these drive rollers.

For example, one may provide two motor driven drive rollers, one driven at a constant speed defining the web speed and the other driven at constant torque defining the web tension. Preferably the web is conveyed through the printer at a speed of from 5 cm/sec to 50 cm/sec and the tension in the web at each image producing station preferably lies within the range of 0.2 to 2.0 N/cm web width.

Alternatively, the substrate may be in the form of cut sheets, the printer being provided with means known *per se* for feeding cuts sheets from an input location to an output location by way of a transfer location where toner images from the drum surface are transferred thereto.

It is also possible for the substrate to be in the form of an intermediate member, from which the images are subsequently transferred to a final support in the form of a web or cut sheets.

In a preferred embodiment, the printer is an electrostatographic single-pass multiple station printer, which comprises a plurality of electrostatographic toner image producing stations each having a drum onto which a toner image can be formed, and means for conveying substrate in the form of a web in succession past said stations.

Preferred embodiments of the invention

The invention will now be further described, purely by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows schematically an electrostatographic single-pass multiple station printer, suitable for simplex printing, showing the positional relationship of the various parts thereof;

Figure 2 shows in detail a cross-section of one of the printing stations of the printer shown in Figure 1;

Figure 3 shows a modification of the printing station shown in Figure 2, incorporating one embodiment of the invention; and

Figure 4 shows an alternative embodiment of the invention, viewed in a direction towards the axis of the drum shown in Figure 2.

Referring to Figure 1, there is shown a printer having a supply station 13 in which a roll 14 of web material 12 is housed, in sufficient quantity to print, say, up to 5,000 images. The web 12 is conveyed into a tower-like printer housing 44 in which a support column 46 is provided, housing four similar printing stations A to D. In addition, a further station E is provided in order to optionally print an additional colour, for example a specially customised colour, for example white. The printing stations A to E are mounted in a substantially vertical configuration resulting in a reduced footprint of the printer and additionally making servicing easier. The column 46 may be mounted against vibrations by means of a platform 48 resting on springs 51.

After leaving the final printing station E, the image on the web is fixed by means of the image-fixing station 16 and fed to a cutting station 20 (schematically represented) and a stacker 52 if desired.

The printing stations (i.e. image producing stations) A, B, C, D and E are arranged in a substantially vertical configuration, although it is of course possible to arrange the stations in a horizontal or other configuration. The web of paper 12 unwound from the supply roll 14 is conveyed in an upwards direction past the printing stations in turn. The moving web 12 is in face-to-face contact with the drum surface 26 over a wrapping angle ω of about 15° (see Figure 2) determined by the position of the guide rollers 36. After passing the last printing station E, the web of paper 12 passes through the image-fixing station 16, an optional cooling zone (not shown) and thence to the cutting station 20 to cut the web 12 into sheets.

The web 12 is conveyed through the printer by two drive rollers 22a, 22b one positioned between the supply station 13 and the first printing station A and the second positioned between the image-fixing station 16 and the cutting station 20. The drive rollers 22a, 22b are driven by controllable motors, 23a, 23b. One of the motors 23a, 23b is speed controlled at such a rotational speed as to convey the web through the printer at the required speed, which may for example be about 125 mm/sec. The other motor is torque controlled in such a way as to generate, in conjunction with brake 11, a web tension of, for example, about 1 N/cm web width.

As shown in Figure 2, each printing station comprises a cylindrical drum 24 having a photoconductive outer surface 26. Circumferentially arranged around the drum 24 there is a main corotron or scorotron charging device 28 capable of uniformly charging the drum surface 26, for example to a potential of about -600 V, an exposure station 30 which may, for example, be in the form of a scanning laser beam or an LED array, which will image-wise and line-wise expose the photoconductive drum surface 26 causing the charge on the latter to be selectively reduced, for example to a potential of about -250 V, leaving an image-wise distribution of electric charge to remain on the drum surface 26. This so-called "latent image" is rendered visible by a developing unit 32 which by means known in the art will bring a developer in contact with the drum surface 26. The developing unit 32 includes a developer brush 33 which is adjustably mounted, enabling it to be moved radially towards or away from the drum 24 for reasons as will be explained further below. According to one embodiment, the developer contains (i) toner particles containing a mixture of a resin, a dye or pigment of the appropriate colour and normally a charge-controlling compound giving triboelectric charge to the toner, and (ii) carrier particles charging the toner particles by frictional contact therewith. The carrier particles may be made of a magnetizable material, such as iron or iron oxide. In a typical construction of a developing unit, the developer brush 33 contains magnets carried within a rotating sleeve causing the mixture of toner and magnetizable material to rotate therewith, to contact the surface 26 of the drum 24 in a brush-like manner. Negatively charged toner particles, triboelectrically charged to a level of, for example 9 μC/g, are attracted to the photo-exposed areas on the drum surface 26 by the electric field between these areas and the negatively electrically biased developer so that the latent image becomes visible.

After development, the toner image adhering to the drum surface 26 is transferred to the moving web 12 by a transfer corona device 34. The moving web 12 is in face-to-face contact with the drum surface 26 over a wrapping angle ω of about 15° determined by the position of guide rollers 36. The charge sprayed by the transfer corona device, being on the opposite side of the web to the drum, and having a polarity opposite in sign to that of the charge on the toner particles, attracts the toner particles away from the drum surface 26 and onto the surface of the web 12. The transfer corona device typically has its corona wire positioned about 7 mm from the housing which surrounds it and 7 mm from the paper web. A typical transfer corona current is about 3 μA/cm web width. The transfer corona device 34 also serves to generate a strong adherent force between the web 12 and the drum surface 26, causing the latter to be rotated in synchronism with the movement of the web 12 and urging the toner particles into firm contact with the surface of the web 12. The web, however, should not tend to wrap around the drum beyond the point dictated by the positioning of a guide roller 36 and there is therefore provided circumferentially beyond the transfer corona device 34 a web discharge corona device 38 driven by alternating current and serving to discharge the web 12 and thereby allow the web to become released from the drum surface 26. The web discharge corona device 38 also serves to eliminate sparking as the web leaves the surface 26 of the drum.

Thereafter, the drum surface 26 is pre-charged to a level of, for example -580 V, by a pre-charging corotron or scorotron device 40. The pre-charging makes the final charging by the corona 28 easier. Thereby, any residual toner which might still cling to the drum surface, which may amount to say 10% of the totally applied toner, may be more easily removed by a cleaning unit 42 shown schematically in Figure 2. The cleaning unit 42 includes an adjustably mounted cleaning brush 43, the position of which can be adjusted towards or away from the drum surface 26 to ensure optimum cleaning. The cleaning brush 43 is earthed or subject to such a potential with respect to the drum as to attract the residual toner particles away from the drum surface. After cleaning, the drum surface is ready for another recording cycle.

After passing the first printing station A, as described above, the web passes successively to printing stations B, C and D, where images in other colours are transferred to the web. It is critical that the images produced in successive stations be in register with each other. In order to achieve this, the start of the imaging process at each station has to be critically timed. However, accurate registering of the images is possible only if there is no slip between the web 12 and the drum surface 26.

The electrostatic adherent force between the web and the drum generated by the transfer corona device 34, the wrapping angle ω determined by the relative position of the drum 24 and the guide rollers 36, and the tension in the web generated by the drive rollers 22a, 22b and the braking effect of the brake 11 are such as to ensure that the peripheral speed of the drum 24 is determined substantially only by the movement of the web 12, thereby ensuring that the drum surface moves synchronously with the web.

The rotatable cleaning brush 43 which is driven to rotate in a sense the same as to that of the drum 24 and at a peripheral speed of, for example twice the peripheral speed of the drum surface. The developing unit 32 includes a developer brush 33 which rotates in a sense opposite to that of the drum 24. The resultant torque applied to the drum 24 by the rotating developing brush 33 and the counter-rotating cleaning brush 43 is adjusted to be close to zero, thereby ensuring that the only torque applied to the drum is derived from the adherent force between the drum 24 and the web 12. Adjustment of this resultant force is possible by virtue of the adjustable mounting of the cleaning brush 43 and/or the developing brush 33 and the brush characteristics.

Figure 3 is a similar view to that shown in Figure 2, with certain features illustrated in more detail. The cleaning unit 42 is slidably mounted in the housing of the printer. The cleaning brush 43 rotates in the direction show, in opposition to the direction of movement of the adjacent surface 26 of the drum 24.

The cleaning wheel 43 contacts a counter-rotating insulative toner removing roller 62. A scraper blade 64 removes toner particles from the toner removing roller 62 and directs them to be accumulated in the upper portion of the cleaning unit to be removed by an auger 66.

A fixed refurbishing brush 68 is mounted on a carrier bar 70 which extends in a direction parallel to the axis of the drum 24. The carrier bar 70 is in turn is secured to the cleaning unit 42 in such a manner as to apply the free ends of the brush filaments against the surface 26 of the drum 24 with slight pressure, sufficient merely to overcome any tolerance in the parallel disposition of the carrier bar 70.

The fibres of the refurbishing brush 68 are formed of 680/40 denier polypropylene having a packing density of 55,000 filaments/cm^2. The filament effective lengths are 8.5 mm. We have found a suitable alternative to be 940/60 denier polyamide having a packing density of 35,000 filaments/cm^2.

The refurbishing brush 68 removes sub-micron particles from the surface 26 of the drum 24 which were not collected by the cleaning brush 43 and thus prevents filming and the build up of extraneous matter in lateral scratches on the surface 26. After about 150,000 A4 sized copies, or equivalent, the cleaning unit 42, together with the attached refurbishing brush 68, is slid out of the printer housing for servicing, during which accumulated extraneous matter on the refurbishing brush 68 is removed with a vacuum cleaner.

Figure 4 shows schematically an alternative embodiment of the invention in which the fixed refurbishing brush of Figure 3 is replaced by a refurbishing brush 72 in the form of a belt passing over rollers 74 and 76. The upper run of the belt brush 72 is backed by a spring loaded support plate 79 which urges the brush filaments into contact with the surface 26 of the drum 24. One of the rollers 74, 76 is coupled to a drive device not shown, to drive the belt at a linear speed of, for example, 0.01 to 1.0 cm/sec. A vacuum cleaner device 78 is positioned adjacent one turning end of the belt brush 72, to constantly remove extraneous matter therefrom. The filament materials used for the belt brush 72 may be similar to those used in the embodiment described in relation to Figure 3.

It is to be understood that while the embodiments of the invention described herein are printers which are adapted to produce multiple printed copies of an image from an electronic form thereof, the present invention is also applicable to machines adapted to produce one, or only a few, printed copies of an image which is in optical form, generated from an original thereof. Such machines are often referred to as "copiers", and the term "printer" used herein should be interpreted to include such machines within its scope.

Cross-reference to co-pending application

A number of features of the printers described herein are the subject matter of European patent application no. EP-A-629924 (Xeikon NV).

Claims

1. A electrostatographic toner image producing station for use in an electrostatographic printer, the electrostatographic toner image producing station comprising:

   - rotatable endless photoconductive surface means (26) onto which a toner image can be formed;
   - charging means (28) for charging said endless photoconductive surface means (26);
   - exposure means (30, 32) for forming an electrostatic latent image on the charged endless photoconductive surface means (26);
   - a development station (32) for depositing toner onto said electrostatic latent image to form a toner image;
   - transfer means (34) for transferring said toner image from said rotatable photoconductive surface means (26) to a substrate (12), and
   - a driven circumferentially rotatable cleaning brush (43) in frictional contact with said endless photoconductive surface means (26), to remove residual toner from said endless photoconductive surface means;

   characterised by the provision of a refurbishing brush (68; 72) in contact with said endless photoconductive surface means after said driven rotatable cleaning brush and in advance of said charging means, to reduce filming and build up of extraneous matter on said endless photoconductive surface means.

2. A electrostatographic toner image producing station according to claim 1, wherein said refurbishing brush (68) is stationary.

3. A electrostatographic toner image producing station according to claim 1, wherein said refurbishing brush is in the form of a belt (72) which can be driven laterally across said rotatable endless photoconductive surface (26).

4. An electrostatographic toner image producing station according to any preceding claim, wherein means (40) are provided, located between said transfer means (34) and said driven rotatable cleaning brush (34), to pre-charge said residual toner.

5. A electrostatographic toner image producing station according to any preceding claim, wherein said photoconductive surface (26) is formed of an organic photoconductor.

6. A electrostatographic toner image producing station according to any preceding claim, wherein said refurbishing brush (68; 72) comprises filaments composed of a material selected from polypropylene, polyamides, polyimides, polyesters, and mixtures thereof.

7. A electrostatographic toner image producing station according to any preceding claim, wherein said refurbishing brush (68; 72) has a filament packing density of between 10,000 and 100,000 filaments/cm^2.

8. A electrostatographic toner image producing station according to any preceding claim, wherein said refurbishing brush (68; 72) comprises electrically non-conductive filaments.

9. A electrostatographic toner image producing station according to any preceding claim, wherein said toner is in dry particulate form.

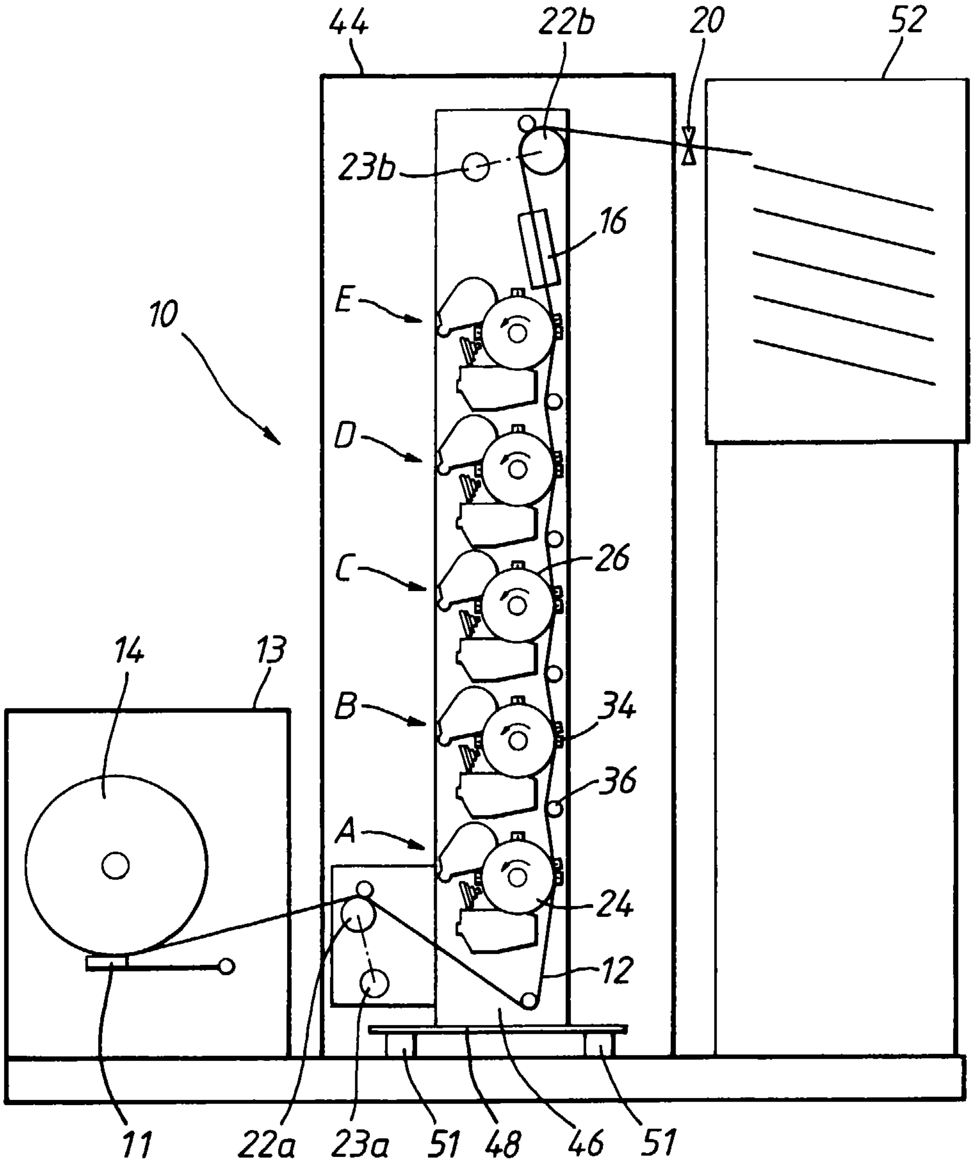
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Fig. 1

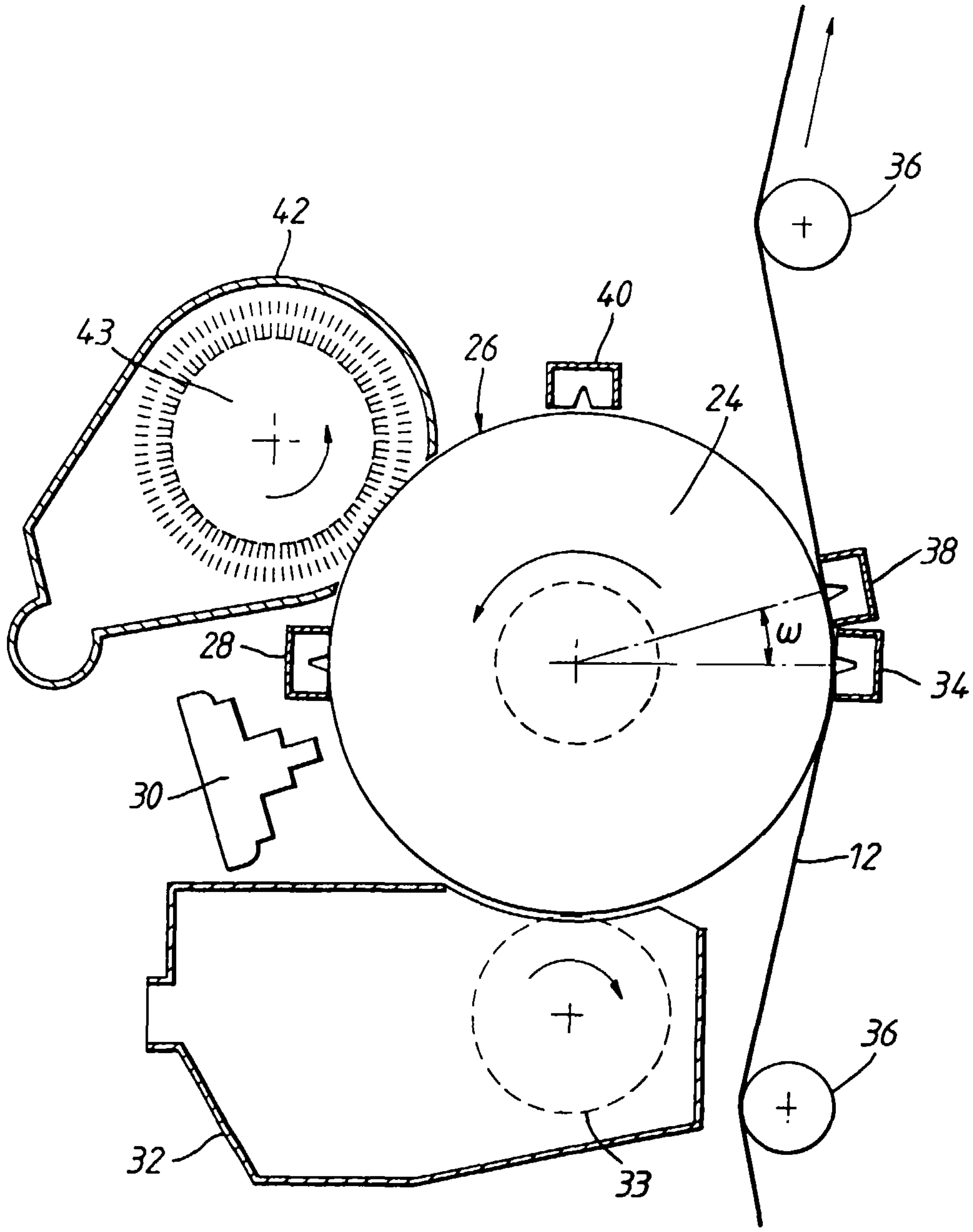

Fig.2

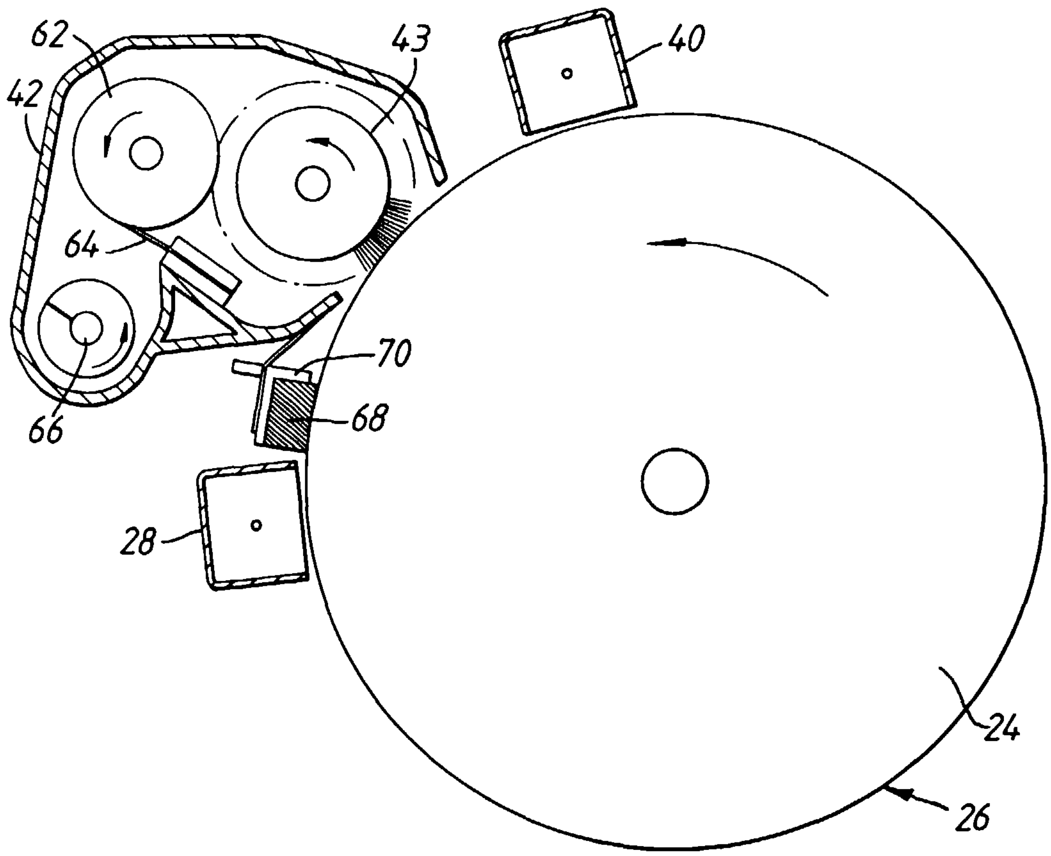

Fig.3

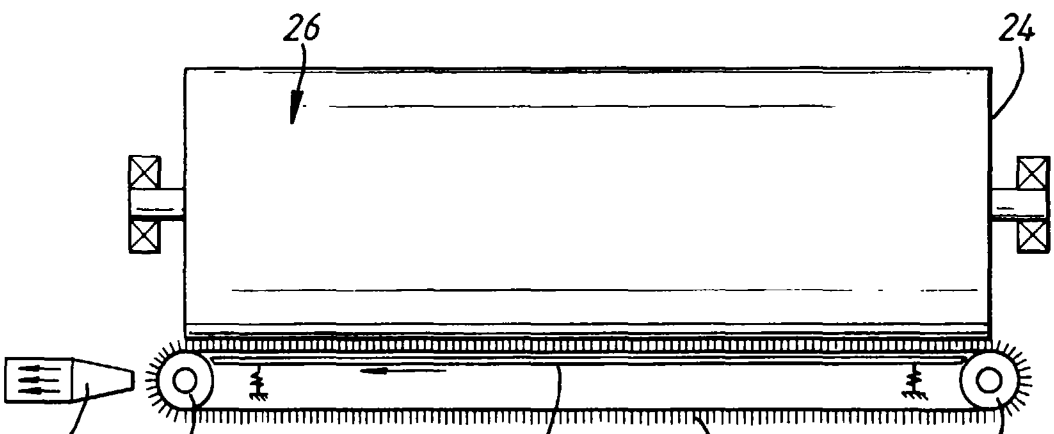

Fig.4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 30 9137

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,A	EP 0 671 672 A (XEIKON NV) 13 September 1995 * the whole document * ---	1	G03G21/00
D,A	EP 0 512 362 A (MITA INDUSTRIAL CO LTD) 11 November 1992 * the whole document * ---	1	
A	US 4 134 673 A (FISHER DONALD J) 16 January 1979 * figure 1 * ---	1	
A	XEROX DISCLOSURE JOURNAL, vol. 19, no. 6, 1 November 1994, page 495/496 XP000484374 KEDARNATH N: "DETONING OF DUAL ELECTROSTATIC BRUSH (ESB) CLEANERS" * the whole document * ---	1	
A	PATENT ABSTRACTS OF JAPAN vol. 010, no. 341 (P-517), 18 November 1986 & JP 61 144681 A (CANON INC), 2 July 1986, * abstract * ---	2	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G03G
A	PATENT ABSTRACTS OF JAPAN vol. 008, no. 045 (P-257), 28 February 1984 & JP 58 196567 A (CANON KK), 16 November 1983, * abstract * ---	1	
A	PATENT ABSTRACTS OF JAPAN vol. 015, no. 247 (P-1219), 25 June 1991 & JP 03 078782 A (RICOH CO LTD), 3 April 1991, * abstract * -----	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	21 March 1997	Hoppe, H

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

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