



(11) Publication number: **0 541 841 A1**

(12) **EUROPEAN PATENT APPLICATION**

(21) Application number: **91119221.9**

(51) Int. Cl.⁵: **B41J 2/385**

(22) Date of filing: **12.11.91**

(43) Date of publication of application:
19.05.93 Bulletin 93/20

(84) Designated Contracting States:
FR GB

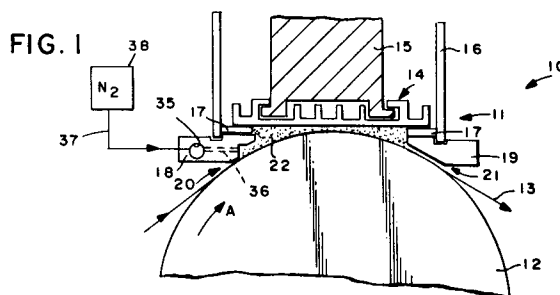
(71) Applicant: **MOORE BUSINESS FORMS, INC.**
300 Lang Boulevard
Grand Island New York 14072-1697(US)

(72) Inventor: **Christy, Orrin D.**
786 Thomas Fax Drive West
North Tonawanda, New York 14120(US)

(74) Representative: **Spence, Anne et al**
Fry, Heath & Spence Mill House Wandle
Road
Beddington Croydon Surrey CR0 4SD (GB)

(54) **Method and apparatus for electrostatic imaging.**

(57) In electrostatic imaging utilizing a silent electric discharge printer print quality is improved by supplying a gas under pressure to the electric discharge region (22) defined by a solid dielectric member (26) with driver (24) and control (25) electrodes on opposite surfaces of the dielectric, with an edge surface of the control electrode disposed opposite the driver electrode to define the discharge region (22) at the junction of the edge surface and the solid dielectric member. "White death", "black death", and "red death" of the ion cartridge (14) may effectively be put off. Nitrogen, or a mixture of nitrogen with a noble gas or the like, is supplied to the discharge region (22). The gas may be supplied to the volume between the control electrode control fingers and a screen electrode (31) of the ion cartridge (14), or may be supplied through a conventional cartridge mounting rail (18) to the first part of the volume between the imaging drum (12) and ion cartridge (14) in the direction of rotation of the imaging drum (12).



BACKGROUND AND SUMMARY OF THE INVENTION

IDAX and MIDAX printing techniques are commercial electrographic imaging techniques that utilize what is referred to as silent electric discharge. In such systems, an ion cartridge is mounted adjacent an imaging drum. The drum then moves into contact with a transfer sheet (e.g. paper). The conventional cartridges utilized in these printing systems include first and second electrodes, typically called the driver and control electrodes, separated by a solid dielectric member, such as a sheet of mica. The control electrode, typically in the form of control fingers, defines an edge surface disposed opposite the driver electrode to define a discharge region at the junction of the edge surface and the solid dielectric member. An alternating potential is applied between the driver and control electrodes of sufficient magnitude to induce charged particle producing electrical discharges in the discharge region, and means are provided for applying a charged particle extraction potential between the control electrode and a further electrode, so that imaging occurs on the imaging drum, or paper or like dielectric moving past the ion cartridge. In most commercial installations a screen electrode is also provided, between the imaging drum and the control electrode, and separated by an insulating spacer from the control electrode. A commercial ion cartridge is typically constructed of a plurality of driver, control, and screen electrode units, in a matrix form.

In commercial installations of MIDAX printers, there typically are three major manners in which the ion cartridges fail. The spot size produced by the ion cartridge grows as the cartridge ages, and once it gets to a particular level so that the print quality is unacceptably poor, the cartridge must be cleaned or retired; or under some circumstances there is catastrophic failure of the cartridge.

One conventional way in which ion cartridges fail is euphemistically referred to as "red death". By-products formed in the ionization process, such as oxides, build up on the cartridge control fingers which can cause an uneven rush of electrons and negative ions upon application of the extraction voltage. Another mode of failure is euphemistically referred to as "white death". In the white death scenario, white crystals, which typically are nitrates, build up on the screen electrode thereby creating a dielectric layer and causing an electrical defocussing of the electron and ion stream as it exits the cartridge. A third typical mode of failure, euphemistically referred to as "black death", is caused by premature catastrophic failure of the cartridge when conductive toner is sucked up into the cartridge and creates unwanted

electrically conductive paths and also localized heating.

According to the invention it has been found that the mechanisms by which at least red and white death occur are dependent upon the characteristics of the atmosphere from which the ions are produced by the ion cartridge. The atmosphere is typically normal air, although it may be contaminated with ammonia, benzene, or other gases depending upon the particular plant in which the system is utilized. Nitrogen, oxygen, and water vapor are the major components of the atmosphere, and during operation of the MIDAX printers after one stream of electrons and ions is created and extracted from the cartridge new air replaces that which was lost from the cartridge. Most of the problems of ion cartridge aging are caused by compounds made of or initiated by oxygen and/or water vapor, and therefore the process can be slowed or even eliminated by the replacement of the air around the ion cartridge with appropriate other gases. Even in situations where ion cartridge life is not extended, however, there may be significant advantages to providing a particular atmosphere in the ion cartridges. For example the quality of the print -- its uniformity -- may be significantly enhanced. Uniformity enhancements on the order of 40% are not unusual when the atmosphere from which the electrons and ions are created by the ion cartridge is properly controlled.

According to the present invention, it has been found that if a substantial portion of the air at the discharge region of the ion cartridge is replaced with nitrogen, elemental noble gases, mixtures of noble gases, or mixtures of nitrogen with one or more noble gases, uniformity and/or cartridge life can be significantly enhanced. If the gas is supplied in a particular manner even black death catastrophic failure can be eliminated or minimized.

Gases that are particularly effective in the practice of the invention are nitrogen, mixtures of nitrogen and helium, and mixtures of nitrogen with argon, xenon, neon, and/or krypton. It has been found that completely dry pure nitrogen is not particularly effective since nitrogen is not easily ionized, and therefore there must be some "catalyst" present to enhance the nitrogen ionization. However the catalyst must be present in small enough amounts so that arcing does not occur, since arcing can be destructive and reduce cartridge life. While water vapor that naturally occurs can provide this catalyst effect, it is desirable for other reasons to keep the amount of water vapor to a minimum. Therefore it is most desirable to add another gas, such as a noble gas, to the nitrogen.

While helium can be effective as a catalyst for nitrogen ionization, if helium is used in a commercial environment it can be dangerous to a human

operator since the helium and nitrogen ionization may generate gases that would make an operator dizzy. Argon, xenon, neon, and krypton do not have that effect, however, yet they provide an effective catalyst for nitrogen ionization. The amounts of argon, neon, krypton, or xenon must be controlled, however, to make sure that they are low enough so that arcing does not occur.

In the preferred form of the present invention, nitrogen is mixed with argon, xenon, neon, or krypton so that there is a volume ratio of about 5 - 1 to about 20 - 1 of nitrogen to other gas. The invention is most effective in some actual operating environments when nitrogen and argon are mixed at a ratio of about 10 to 1. Typically the gas mixture is supplied to the discharge region at a rate of about 4.75 - 6.25 cubic feet per hour, typically about .5 cubic feet per hour of argon, xenon, neon, or krypton, and about 5 cubic feet per hour nitrogen.

A number of particularly advantageous mechanisms for introducing the gas to the discharge region are provided according to the invention. Black death can be significantly reduced if the gas is introduced through the insulating spacer between the control electrode and the screen electrode. The gas is typically introduced at a pressure above atmospheric pressure so that a positive pressure is provided in this area, and conductive toner can therefore not be easily sucked into the ion cartridge. Alternatively, the gas may be injected through a plenum and holes spaced about one-half inch along a pre-existing cartridge mounting rail, typically the first rail in the direction of rotation of the imaging drum. Alternatively, a pair of gas manifolds may be provided at opposing ends of the imaging drum, and a pair of spray tubes extending between the gas manifolds with a plurality of openings provided along their length. The gas is then supplied by regulators and conduits to the gas manifolds, and thus introduced uniformly between the ion cartridge and the imaging drum.

According to one aspect of the present invention, an improved method of generating charged particles for electrostatic imaging which comprises the following steps: applying an alternating potential between a first electrode substantially in contact with one side of a solid dielectric member and a second electrode substantially in contact with an opposite side of the solid dielectric member, said second electrode having an edge surface disposed opposite said first electrode to define a discharge region at the junction of the edge surface and the solid dielectric member, to induce charged particle producing electrical discharges in said air region between said solid dielectric member and the edge surface of said electrode; applying a charged par-

ticle extraction potential between said second electrode and a further electrode member to extract charged particles produced by the electrical discharges in said air region; and applying the external charged particles to a further member to form an electrostatic image; wherein the improvement comprises supplying a controlled gas to the discharge site to displace at least some of the air during charged particle generation, said controlled gas being selected from the group consisting of nitrogen, elemental noble gasses, mixtures of elemental noble gasses, and mixtures of nitrogen with one or more elemental noble gasses.

According to another aspect of the present invention, there is provided improved apparatus for generating electrostatic images of the type including a solid dielectric member. The apparatus comprises a "driver" electrode substantially in contact with one side of the solid dielectric member; a "control" electrode substantially in contact with an opposite side of the solid dielectric member, with an edge surface of said control electrode disposed opposite said driver electrode to define a discharge site at the junction of said edge surface and said solid dielectric member; means for applying an alternating potential between said driver and control electrode of sufficient magnitude to induce charged particle producing electrical discharges in said discharge site between the solid dielectric member and the edge surface of the control electrode; means for applying a charged particle extraction potential V_c between the control electrode and a further electrode member to extract ions produced by the electrical discharges in said air region and apply these charged particles to a dielectric surface to form an electrostatic image thereon, a third ("screen") electrode; a solid dielectric layer separating said screen electrode from the control electrode and the solid dielectric member; and a source of "screen" voltage V_s between the screen electrode and the further electrode member, wherein V_s has a magnitude greater than zero and the same polarity as V_c ; wherein the improvement comprises means for supplying a controlled gas to the discharge site to displace at least some of the air during charged particle generation, said controlled gas comprising a gas selected from the group consisting of nitrogen, elemental noble gasses, mixtures of elemental noble gasses, and mixtures of nitrogen with one or more elemental noble gasses. A multiplicity of driver and control electrodes form cross points in a matrix array configured such that the control electrodes contain openings at matrix electrode crossover regions, wherein the controlled gas is supplied to these openings.

It is the primary object of the present invention to provide for enhanced uniformity and/or en-

hanced cartridge life in silent electric discharge electrographic imaging. This and other objects of the invention will become clear from an inspection of the detailed description of the invention and from the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side schematic view, partly in cross-section and partly in elevation of an apparatus for electrostatic imaging according to the present invention, and for practicing the method of the present invention;

FIGURE 2 is a side schematic primarily cross-sectional view of the details of the ion cartridge of the FIGURE 1 apparatus;

FIGURE 3 is a detail schematic cross-sectional view of another embodiment of apparatus for feeding gas to the ion discharge region of apparatus according to the invention;

FIGURE 4 is an exploded perspective schematic view of still another embodiment for the supply of gas to the discharge region, according to the invention; and

FIGURE 5 is a top schematic view of the apparatus of FIGURE 4, also showing the gas sources and regulating apparatus.

DETAILED DESCRIPTION OF THE DRAWINGS

An exemplary apparatus according to the present invention is shown generally by reference numeral 10 in FIGURE 1. The main components include the silent electric discharge ion generating system 11, and an imaging drum 12 or like device for moving a dielectric, such as dielectric belt or dielectric paper web 13 or dielectric surface of drum 12, past the SED apparatus 11. Most of the components of the SED apparatus 11, and the imaging drum, are conventional.

One of the major components of the SED apparatus 11 comprises the ion cartridge 14 which is mounted by a cartridge mounting block 15 within a casing defined by driver printed circuit board 16 and cartridge connectors 17. The structures 16, 17 are supported by a pair of cartridge mounting rails 18, 19 that are elongated in the direction of elongation of the drum 12 and the ion cartridge 14. The drum 12 is mounted for rotation in the direction A by a shaft, bearings, and like conventional components, and so that it is spaced only a small distance from each of the rails 18, 19, defining gaps 20, 21 therewith. Typically the gaps 20, 21 have a width of less than about .002 inches (0.051 mm). An interior volume 22 is provided between the ion cartridge 14 and the imaging drum 12.

The ion cartridge 14 is of conventional construction, such as shown in U.S. patents 4,155,093,

4,160,257, 4,267,556, and/or 4,381,327. FIGURE 2 very schematically illustrates one component of the ion cartridge 14, there being many such components arranged throughout the length of the ion cartridge 14 (typically in matrix form) to provide electrostatic charges to the dielectric web or belt 13. The major components of the cartridge 14 schematically illustrated in FIGURE 2 comprise a first or driver electrode 24, a second or control electrode 25 typically formed by a plurality of control fingers, and a solid dielectric member 26 disposed therebetween. Typically the member 26 is mica in commercial installations, however according to the invention improved performance and longevity are possible so that other solid dielectric members besides mica may be practical.

A high voltage alternating potential 28 is applied between the driver and control electrodes 24, 25 to cause the formation of a pool or plasma of positive and negative charged particles in the region adjacent the dielectric 26 at an edge surface of the control electrode 25, which charged particles may be extracted to form a latent electrostatic image on the dielectric belt or web 13 or drum 12 periphery. Charged particles of a given polarity may be extracted from the plasma by applying a bias potential 29 of appropriate polarity between the second electrode 25 and a further electrode, which typically would comprise the image drum 12 itself. Also in most commercial installations, a screen electrode 31 defining a screen aperture 32 is provided spaced by an electrical insulator 30 from the second electrode 25. The screen voltage should be in a relatively narrow range, e.g. -400 to -900. The screen voltage is determined in part by the distance of the screen 31 from the drum 12. At a distance of 0.0010 inches (0.025 mm), the optimum screen voltage is about -700, and could be increased to about -800 before arcing occurs.

As seen in FIGURE 2, constant power supply 33 (typically a voltage of about -700) and variable power supply 34, and a switch 27, are provided in addition to power supply 29 (typically a voltage of about -275). The power supply 34 typically has a range of about +200 to about +300 (e.g. about +250). When switch 27 is in the right (no-print) position in FIGURE 2, the power supply 29 is bypassed, and there is a voltage of about -450 to the control electrode 25 (e.g. $-700 + +250 = -450$). When the switch 27 is in the left position in FIGURE 2, that is the print position, there is about a -715 voltage to control electrode 25 (e.g. $-700 + +250 + -275 = -715$). The screen electrode 31 provides an electrostatic lensing action preventing accidental image erasure and focussing of the electrostatic discharge onto the drum 12 periphery. In most commercial installations, a dielectric belt or web 13 need not pass past the ion

cartridge 14, but rather the peripheral surface of the imaging drum 12 is dielectric, and that surface moves into operative association with a receptor sheet, such as a paper sheet, which cooperates with a transfer roll.

What has been heretofore described is conventional. According to the invention, at least some of, and preferably the vast majority of, the gas in the volume 22 (i.e. at the discharge region of the control electrode 25) is replaced with gas having particular qualities so as to enhance the uniformity of the print quality, and/or to extend the life of the ion cartridge 14.

The apparatus according to the present invention comprises means for supplying a control gas to the discharge region during the generation of charged particles. The control gas -- which in the FIGURE 1 embodiment is supplied directly to the volume 22 -- comprises a gas selected from the group consisting essentially of nitrogen, elemental noble gases, mixtures of elemental noble gases, and mixtures of nitrogen with one or more elemental noble gases. It is not essential that all contaminants be removed from the gases, and in fact where pure nitrogen is utilized it is necessary that water vapor, or some other catalyst to facilitate nitrogen ionization, be present in order for the system to work properly. However it has been found that almost 100% pure nitrogen supplied as illustrated in FIGURE 1, or in a like manner, combined with the natural water vapor from the paper or other components introduced into the system, works satisfactory to at least enhance print uniformity. Nitrogen mixed with helium is also effective, however in commercial installations where an operator will be located adjacent to the printing apparatus 10 helium is not desirable since by-product gases are produced which can have undesirable side effects when inhaled, and thereby pose a safety hazard. It has been found that it is particularly desirable, however, to provide a particular mixture of nitrogen with one or more of argon, krypton, xenon, or neon, most preferably argon.

According to the invention it has been determined that the amount of noble gas to be mixed with nitrogen (when a nitrogen noble gas mixture is utilized) should be enough to provide a catalyst for nitrogen ionization. However since elemental noble gas present in too large a quantity will cause arcing to occur, the amount of noble gas must be limited by that criteria. In actual experiments it has been found that a mixture of nitrogen and one or more of argon, krypton, xenon, or neon gases -- particularly argon -- is most suitable, the volume ratio of nitrogen to other gas being in the range of 5 to 1 to 20 to 1, most desirably about 10 to 1. The flows of the gases making up the mixture

are controlled so that the total gas mixture flow to the discharge region is at a rate of about 4.75 - 6.25 cubic feet per hour, most typically by supplying nitrogen at about 5 cubic feet (0.14 cu. metres) per hour and the other gas, e.g. argon, at about .5 cubic feet (0.014 cu. metres) per hour.

Supply of gas to the volume 22 in the FIGURE 1 embodiment is provided by utilizing the pre-existing cartridge mounting rail 18 at the "first" portion of the imaging drum 12 as it rotates in direction A into the volume 22, so that gas passes with the rotating drum toward the gap 21. This is preferably provided by forming a plenum 35 in the rail 18, with a plurality of through-extending openings or jets 36 from the plenum 35 to the volume 22, preferably the openings or jets 36 being spaced from each other about one half inch along the length of the rail 18. A conduit 37 leading from a source 38 of pressurized nitrogen, or other gas pursuant to the invention, supplies the controlled gas to the plenum 35. The source 38 can be either compressed nitrogen or like gas, or a liquid nitrogen dewar, or a Prima Alpha Separated nitrogen filter attached to a compressed air source.

With the proper control of gas to the volume 22, the apparatus 10 of FIGURE 1 can greatly assist in extending the life of the ion cartridge. That is the avoidance of red death and white death may be provided. However a small amount of air, and other materials, may still pass into the volume 22, and therefore it is possible that conductive toner particles may accidentally be drawn into the volume 22, which conductive toner would burn and result in premature catastrophic failure of the cartridge 14. In order to prevent this "black death", the apparatus illustrated in FIGURE 3 may be utilized.

In the FIGURE 3 drawing, elements that are comparable to those in the FIGURES 1 and 2 embodiment are illustrated by the same reference numeral only preceded by a "1".

In FIGURE 3, the first or driver electrode 124 is shown mounted on a conventional backing insulator 40, which in turn is connected to an aluminum backbone 41. The mica dielectric member 126 is disposed between the driver electrode 124 and the control electrode fingers 125, with an insulating spacer 130 separating the screen electrode 131 from the control fingers 125. In this embodiment, the nitrogen or like gas under pressure (that is greater than ambient pressure) is introduced into the discharge region through the insulating spacer 130, having a vector generally parallel to the control fingers 125, by the openings or jets 136 connected to the plenum 135. The gas for ionization at the discharge region flows outwardly through the opening 132 in the screen electrode 131, along with the ions, and since a positive pressure is

maintained at the discharge region it is extremely unlikely that conductive toner particles could enter that area and thereby cause "black death".

The embodiment of FIGURES 4 and 5 is still another embodiment of the apparatus for supplying the desired gases to the discharge region, according to the invention. In the FIGURES 4 and 5 embodiment, structures comparable to those in the FIGURES 1 and 2 embodiment are illustrated by the same reference numeral only preceded by a "2". In this embodiment, the ion cartridge 214 is shown in operative association with a support 45, which provides a positive electrical connection adjacent the image drum 212. Gas is supplied via the gas manifolds 47, 48 which are mounted on opposite region ends of the cartridge 214 and drum 212. A pair of spray tubes 49, 50 having a plurality of openings 51, 52 respectively therein extend between the manifolds 47, 48 and supply gas directly to the "top" of the drum 212 (as oriented in FIGURE 4), and just below the ion cartridge 214, to provide the vast majority of the gas at the discharge region.

Gas is supplied to the manifolds 47, 48 by conduits 54, 55 which are connected to a tee fitting 56, which in turn is connected by conduit 58 to a second tee fitting 59 (see FIGURE 5). In the preferred embodiment illustrated herein, a source of nitrogen under pressure, 61, and a source of argon under pressure, 62, are provided to supply the ionizing gas. The sources 61, 62 are connected by conventional regulators and metering devices 63, 64 to the tee fitting 59. The regulator/metering devices 63, 64 control the flow rates of nitrogen and argon (or xenon, krypton, or neon) so that they are in the appropriate range.

The board 45 may have spring loaded pins 67 for engaging 214, and electrical connectors 68 for the drive electrode of the ion cartridge.

In the preferred embodiment, the ratio of nitrogen to argon (or xenon, krypton, or neon) is about 5 to 1 to 20 to 1, most preferably about 10 to 1. The flow rate is regulated so that the gas mixture supplied to the region by the tubes 49, 50 is (for the FIGURES 4 and 5 embodiment of apparatus) at a rate of about 4.75–6.25 cubic feet (0.134 to .177 cu. metres) per hour. This rate may change depending upon the particulars of the geometry for applying the gas to the discharge region, but would be at an equivalent range taking into account the differences in the supply apparatus. Most desirably, the nitrogen would be supplied at about 5 cubic feet (0.14 cu. metres) per hour while the argon (or xenon, neon, or krypton) at a rate of about .5 cubic feet (0.014 cu. metres) per hour. The nitrogen flow rate could vary about plus or minus 10%, and the argon flow rate could vary about plus or minus 50%. It is necessary, however,

that the amount of argon, or like gas, be supplied to the nitrogen stream so as to be effective to provide a catalyst for nitrogen ionization; however the amount must be low enough to prevent arcing since arcing more readily occurs the higher the percentage of argon or the like.

Utilizing the ratios heretofore described it is possible in an actual commercial installation of a MIDAX printer to increase the cartridge life (i.e. with respect to red and white death). At ratios significantly outside this range, for the supply apparatus illustrated in FIGURES 4 and 5, the same results cannot be expected.

Reference is made to the following non-limiting examples which show some of the results achievable according to the invention:

Example 1

Utilizing an apparatus generally similar to that in FIGURE 1, so that the volume surrounding a conventional MIDAX ion cartridge associated with an imaging drum is shrouded, approximately 100% nitrogen gas was supplied to the volume 22. In actual operation of the system 10, the uniformity of the hole to hole ion cartridge output increased approximately 40%. Sufficient water vapor or like components were able to enter the system so as to provide a catalyst for the nitrogen ionization.

Example 2

Again utilizing the apparatus generally such as illustrated in FIGURE 1, a mixture of about 4:1, nitrogen to helium, by volume, was added to the volume 22. Again the print quality uniformity was significantly enhanced. While sufficient testing was not done to know for positive whether or not the ion cartridge life was extended in its real life environment, extrapolation of the results indicated that it clearly would be.

Example 3

Utilizing apparatus as illustrated generally in FIGURES 4 and 5, about 5 cubic feet per hour of nitrogen and about .5 cubic feet (0.014 cu. metres) per hour of argon were mixed in tee fitting 59 and in the subsequent conduits, being supplied in controlled quantities by regulators 63, 64, and were introduced through the spray tubes 49, 50. In an actual commercial plant environment, the life of the MIDAX ion cartridge 214 was extended significantly. If the argon concentration was reduced below a volume ratio of about 20 to 1, there was insufficient argon to provide a catalyst for ionization and poor and/or intermittent ionization will take place, resulting in poor print quality. When the

amount of argon is increased above about 5 to 1, in its real life testing there was too high a potential of arcing to expect the type of longevity desired.

It is also noted that in the MIDAX control system, control of internal operating voltages may be effected from an operator control panel (not shown). Thus in the practice of the invention, if the operator notices that the print quality is degrading, he can increase the voltage to ion cartridge 14, and operate the regulators 63, 64 to close of the cylinders 61, 62. While good quality printing (due to the increased voltage) continues, he can then replace the gas bottles 61, 62, and once he reestablishes the gas supply utilizing regulators 63, 64, he can then reduce the voltage back to normal. In this way the system can be continuously run without a degradation in print quality while changeover of gas supplies takes place.

It will thus be seen that according to the present invention enhanced print uniformity and/or ion cartridge longevity for a MIDAX printer can be achieved by supplying the desired gas at the discharge region. While the invention has been herein shown and described in what is presently conceived to be the most practical and preferred embodiment thereof, it will be apparent to those of ordinary skill in the art that many modifications may be made thereof within the scope of the invention, which scope is to be accorded the broadest interpretation of the appended claims so as to encompass all equivalent structures and methods.

Claims

1. A method of generating charged particles for electrostatic imaging which comprises:

applying an alternating potential between a first electrode (24) substantially in contact with one side of a solid dielectric member (26) and a second electrode (25) substantially in contact with an opposite side of the solid dielectric member, said second electrode having an edge surface disposed opposite said first electrode to define a discharge region at the junction of the edge surface and the solid dielectric member, to induce charged particle producing electrical discharges in said discharge region between said solid dielectric member and the edge surface of said electrode

applying a charged particle extraction potential between said second electrode and a further electrode member (12) to extract charged particles produced by the electrical discharges and

applying the external charged particles to a further member (13) to form an electrostatic

image,

characterised by supplying a controlled gas to the discharge region (22) to displace at least some of the ambient air during charged particle generation, said controlled gas being selected from the group consisting of nitrogen, elemental noble gases, mixtures of elemental noble gases, and mixtures of nitrogen with one or more elemental noble gases.

2. The method of Claim 1 wherein the controlled gas is nitrogen, argon, helium or mixtures of nitrogen and argon.

3. The method of Claim 1 or Claim 2 wherein the supplying step comprises creating a flow of the controlled gas into and out of the discharge region.

4. The method of any of Claims 1 to 3 further comprising the step of limiting the volume of ambient air supplied to the discharge region in a mixture with said controlled gas.

5. The method of any of Claims 1 to 4 wherein the supplying step comprises supplying controlled gas to said discharge region at higher than ambient pressure.

6. The method of any of Claims 1 to 5 further comprising the step of controlling the extraction of charged particles using a screen electrode.

7. The method of any of Claims 1 to 6 wherein the supply of controlled gas to the discharge site is limited to avoid arcing between the screen electrode and the further member in the form of a dielectric imaging member, and wherein the controlled gas composition is selected to avoid undue arcing between the screen electrode and dielectric imaging member.

8. Apparatus for generating charged particles for electrostatic imaging which comprises;

a solid dielectric member (26);

a first driver electrode (24) substantially in contact with one side of said solid dielectric member;

a second control electrode (25) substantially in contact with an opposite side of said solid dielectric member, with an edge surface of said second electrode disposed opposite said first electrode to define a discharge region at the junction of said edge surface and said solid dielectric member;

means (28) for applying an alternating

potential between said first and second electrodes of sufficient magnitude to induce charged particle producing electrical discharges in said discharge region between the dielectric member and the edge surface of said second electrode; and means (29) for applying a charged particle extraction potential V_c between said second electrode (25) and a further electrode (12),

characterised by means (35–38) for supplying controlled gas to the discharge region (22) to displace at least some of the ambient air at said discharge region during the generation of charged particles, said controlled gas comprising a gas selected from the group consisting of nitrogen, elemental noble gases, mixtures of elemental noble gases, and mixtures of nitrogen with one or more elemental noble gases.

9. Apparatus according to Claim 8 in which the extraction potential V_c between the control electrode and the further electrode member is arranged to extract ions produced by the electrical discharges in said discharge region and apply these charged particles to a dielectric surface (13) to form an electrostatic image thereon, and including a third screen electrode (31); an insulating spacing member (30) separating said screen electrode from the control electrode (25) and the solid dielectric member (26); and a source (33) of screen voltage V_s between the screen electrode (31) and the further electrode member (12), wherein V_s has a magnitude greater than zero and the same polarity as V_c .

10. Apparatus as defined in Claim 8 or Claim 9 in which a multiplicity of driver control electrodes form cross points in a matrix array configured such that the control electrodes contain openings at matrix electrode crossover regions, characterised in that the supplying means supplies the controlled gas to said openings.

11. Apparatus as defined in Claim 9 in which a multiplicity of driver and control electrodes form cross points in a matrix array configured such that the control electrodes contain openings at matrix crossover regions, said solid dielectric layer contains apertures corresponding to said openings, and said screen electrode comprises a conducting member containing a series of apertures corresponding to said openings, wherein the supplying means supplies controlled gas to the openings in said control electrode.

12. Apparatus as defined in any of Claims 8 to 11, including a plurality of discharge sites and wherein the supplying means include means for distributing controlled gas to said discharge sites in a substantially uniform distribution.

13. Apparatus as defined in any of Claims 8 to 12, further comprising means for substantially eliminating the ambient air supplied to the discharge region with the controlled gas.

14. Apparatus for electrostatic imaging according to any of Claims 8 to 13 in which the means for generating charged particles comprises an ion cartridge (14) and including an imaging drum (12);

means for mounting said imaging drum for rotation with respect to said ion cartridge, with the surface of said imaging drum moving in a tangential direction adjacent to the edge surface;

a pair of cartridge mounting rails (18,19) for mounting the cartridge so that a straight line therebetween intersects the imaging drum, a small gap provided between the rails and the imaging drum; and

the means for supplying a gas being arranged to supply the gas through at least one of said rails to the volume between said ion cartridge and said imaging drum.

15. Apparatus as recited in Claim 14 wherein said means for supplying gas comprises means defining a plenum (35) in at least one (18) of said cartridge mounting rails, with a plurality of openings (36) extending from said plenum to the volume between said ion cartridge and said imaging drum.

16. Apparatus as recited in Claim 14 or Claim 15 wherein said means for supplying gas comprises means for supplying gas to only one (18) of said cartridge mounting rails, said cartridge mounting rail (18) comprising an upstream one of the rails in the direction of rotation of the drum so that as gas is supplied to the volume between the ion cartridge and the drum it moves with the drum.

17. Apparatus for electrostatic imaging comprising; an ion cartridge (14) for generating charged particles and including; a solid dielectric member (26); a driver electrode (24) substantially in contact with one side of the solid dielectric member; a control electrode (25) in contact with an opposite side of the dielectric member and defining an edge surface discharge region; a screen electrode

(31), with an insulating spacer (30) between the control electrode and the screen electrode such that a space (22) is defined between the control electrode, screen electrode and insulating spacer;

5

means (28) for applying an alternating potential between the driver and control electrodes of sufficient magnitude to induce charged particle producing electrical discharges in the discharge region between the dielectric member and the edge surface of the control electrode; and means (29) for applying a charged particle extraction potential between said control electrode (25) and a further electrode (12);

10

15

an imaging drum (12) adjacent said screen electrode;

and means for supplying a gas other than air and of a controlled composition under pressure to said space so that the gas passes through the screen electrode.

20

25

30

35

40

45

50

55

FIG. 1

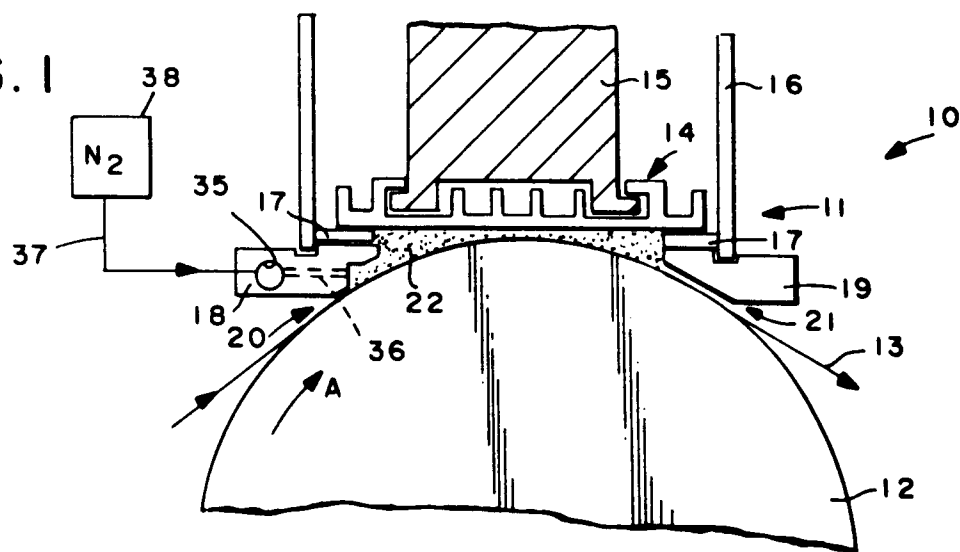


FIG. 2

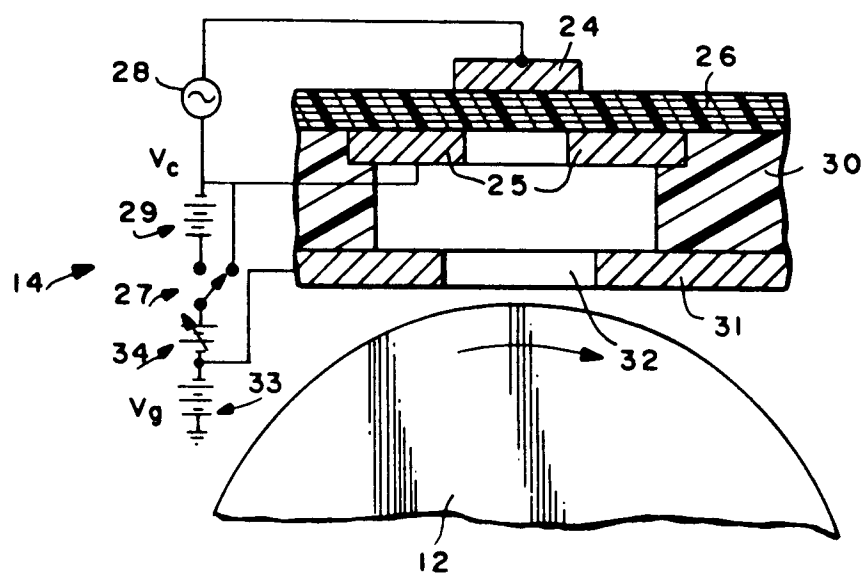


FIG. 3

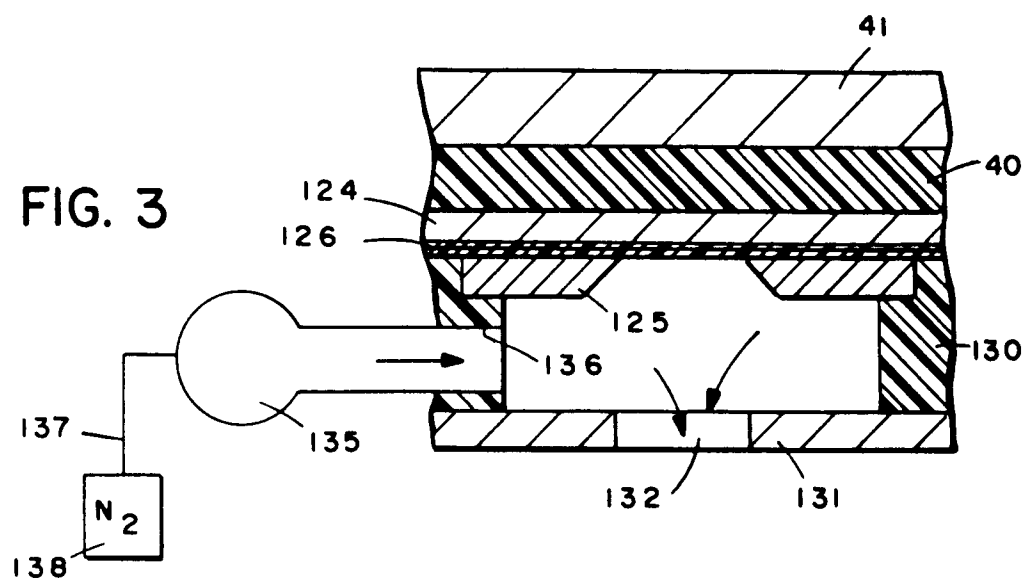


FIG. 4

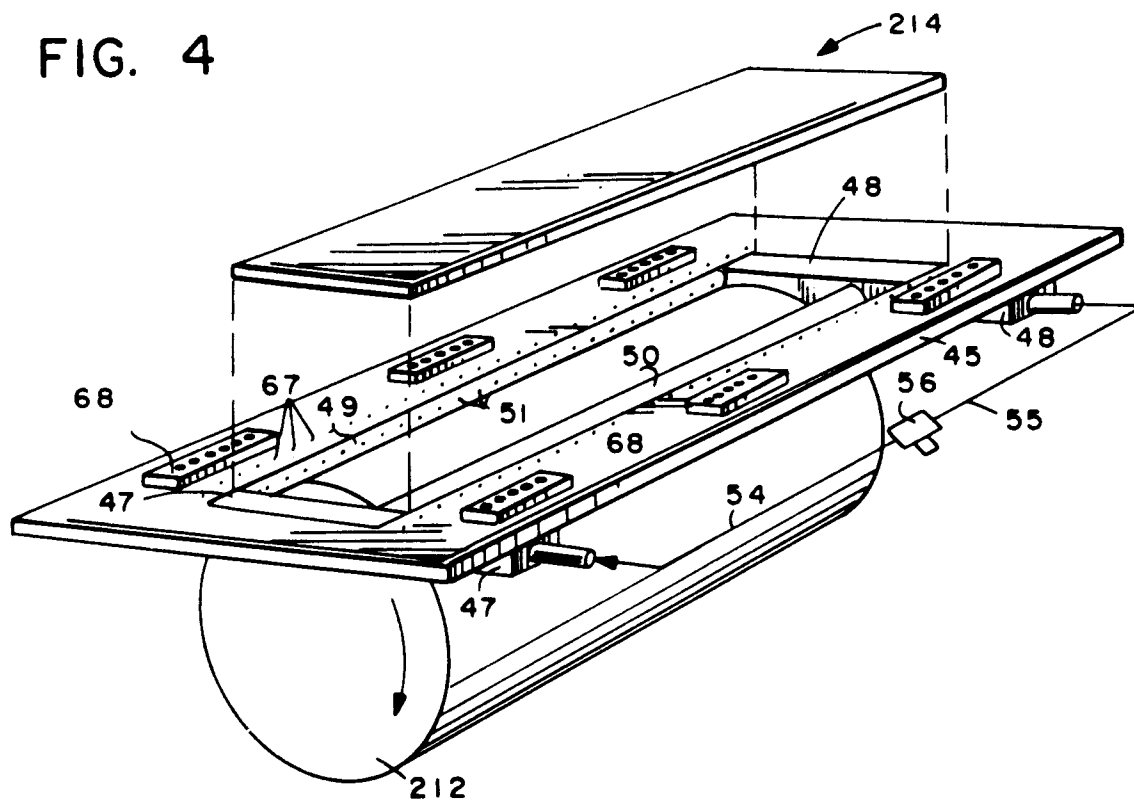
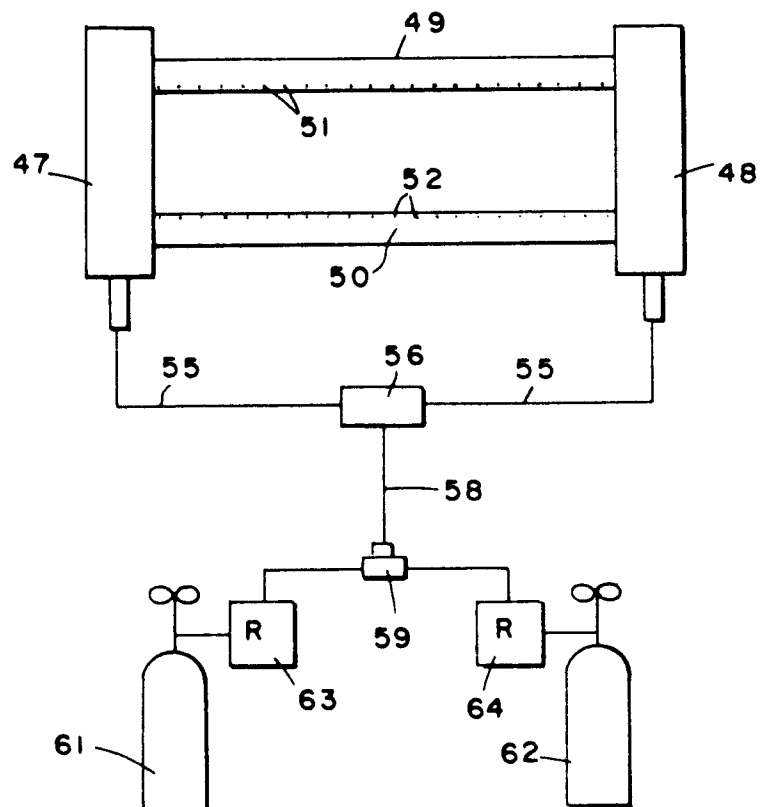


FIG. 5





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 91 11 9221

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.5)
A	DE-A-2 645 928 (AGFA-GEVAERT AG) * claim 6; figure 2 * ---	1-3,8, 17	B 41 J 2/385
A	DE-A-2 515 578 (SIEMENS AG) * page 2; figure 1 * ---	1,2,8, 17	
A	DE-A-2 148 001 (AGFA-GEVAERT AG) * claims 1-3 * -----	1-3,8, 17	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B 41 J G 03 G
The present search report has been drawn up for all claims			
Place of search BERLIN		Date of completion of the search 24-06-1992	Examiner ZOPF K
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 T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			