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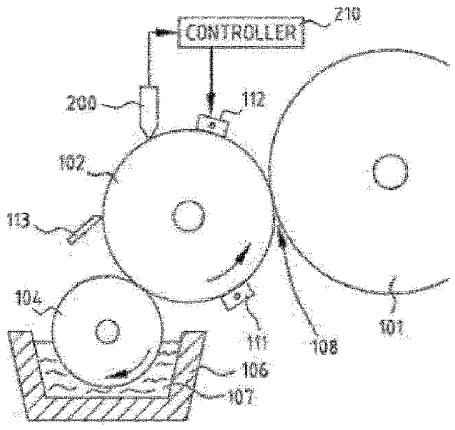
(54) **Digital printing system with improved toner removal.**

(57) A digital printing apparatus comprising a developing roller (102) and an image carrying roller (101); said developing roller (102) being arranged to transfer liquid toner (107) onto said image carrying roller (101) in accordance with a charge pattern; an upstream charger (111) upstream of an area (108) of rotational contact between said developing roller (102) and said image carrying roller (101); a downstream discharger (112, 122, 132) downstream of said area (108); a sensor (200) downstream of said area (108) to detect a property representative of the charge of a liquid toner residue; and a controller (210) to receive sensor data from said sensor (200) and to provide a control signal to control said downstream discharger.



NL C 2010573

Digital printing system with improved toner removal

The present invention pertains to the field of digital printing apparatus, in particular systems using liquid toner, and more in particular to a digital printing apparatus according to the preamble of claim 1.

Digital printing apparatus using liquid toner are known from US patent application publication no. 2011/0249990. The known digital printing apparatus comprises a feed roller, a developing roller, developing roller cleaning means, and an image carrying roller; the feed roller being arranged to transfer a quantity of liquid toner from a reservoir onto the developing roller; and the developing roller being arranged to transfer a portion of the quantity of liquid toner onto the image carrying roller in accordance with a charge pattern sustained on a surface of said image carrying roller.

In digital printing systems of this kind, it is necessary to remove the liquid toner residue that remains on the surface of the developing roller after contact with the imaging roller (typically a roller with a photoconductive surface, adapted to carry a latent image formed by a pattern of charges on that surface). The removal of this residue is quite challenging.

Unpublished European patent application no. 12 175 762.9 in the name of the Applicant describes the use of an oscillating electric field arranged to substantially decompactify the chargeable imaging particles in a liquid toner residue on a developing roller, prior to or during its mechanical removal.

In the digital printing apparatus according to the aforementioned US patent application publication no. 2011/0249990, an upstream corona charger is arranged opposite to a surface of the developing roller downstream of the area of its rotational contact with the feed roller and upstream of the area of its rotational contact with the image carrying roller, and a downstream corona discharger is arranged opposite to a surface of the developing roller downstream of the area of its rotational contact with the image carrying roller and upstream of the area of its rotational contact with the developing roller cleaning means. The downstream corona discharger applies charges which are of a polarity opposite to that of charges applied by the upstream corona charger to impart a force to toner particles that are flocculated or agglutinated to remain on the surface of the developing roller by the upstream corona charger. It is alleged that the resulting force acts in a direction in which the toner particles come off the surface of the developing roller, and it is claimed that this results in easier removal of the residual toner from the surface of the developing roller.

It has been found, however, that the arrangement of US 2011/0249990 does not always lead to optimal removal of the residual liquid toner.

It is a purpose of embodiments of the present invention to provide a digital printing system allowing for improved residual toner removal.

This goal is achieved by a digital printing apparatus which is distinguished by the features of the characterizing

portion of claim 1. The digital printing apparatus comprises a developing roller and an image carrier roller. An upstream charger is arranged upstream of an area of rotational contact between the developing roller and the image carrying roller. A downstream discharger is arranged downstream of the area of rotational contact. A sensor is arranged downstream of the area of rotational contact and is adapted to detect a property representative of the charge of a liquid toner residue downstream of the area of rotational contact. A controller is arranged to receive sensor data from the sensor and to provide a control signal to control the downstream discharger based on the received sensor data.

The present invention goes against the teaching of US 2011/0249990, in that it does not aim at imparting a fixed inverse charge onto the imaging particles, but rather at controlling the charge of the liquid toner residue. More in particular the object of embodiments of the invention is to impart a controlled low charge on the imaging particles downstream of the downstream discharger, preferably rendering the imaging particles downstream of the downstream discharger more or less electrically neutral.

Embodiments of the present invention are based *inter alia* on the inventive insight that two distinct but related effects have to be overcome to efficiently remove the liquid toner from the developing roller: the tendency of the imaging particles to stay close to the surface of the roller (this “compacting” of the toner is in fact deliberately induced to a certain degree at the charging stage), and the tendency of the imaging particles to cling together in large quantities to form gelatinous structures (known as “caking”).

Embodiments of the present invention are based *inter alia* on the surprising discovery by the inventors, that bringing the average charge of the imaging particles back to a small value or to zero yields the highest effectiveness of the developing roller cleaning means. This discovery is surprising because it could be expected that simply taking the liquid toner out of the electric field of the developing roller, *e.g.* by transferring it to an uncharged cleaning roller, would cause the toner to spontaneously decompact as a result of the mutual repulsion of the electrically charged imaging particles. This turns out not to be the case, presumably because other small-scale mechanical and physico-chemical effects tend to keep the liquid toner in a partially caked form, which resists the decompacting forces.

The sensor is preferably arranged downstream of the discharger such that a closed-loop control system is obtained. According to a less preferred variant of the invention, the sensor is arranged between the downstream discharger and the area of rotational contact between the developing roller and the image carrying roller, such that an open-loop control system is obtained.

The controller is preferably configured to control the downstream discharger such that the residual charge of the liquid toner residue at a location downstream of the discharger is within a predetermined range. This range is preferably chosen in such a way that the tendency of the imaging particles of the liquid toner residue to stay close to the surface and the tendency of the imaging particles to cling together in large quantities, are removed. Typically, the controller is configured to minimize the absolute value of this residual charge.

The downstream discharger is preferably configured to produce an electric field in the liquid toner residue, wherein the control signal sent to the discharger pertains to at least one of a DC bias voltage or a DC bias current applied to produce the electric field. More preferably, the downstream discharger is configured to produce an oscillating electric field. The control signal may then pertain to at least one of a DC bias voltage or current, and, and/or a frequency and/or amplitude of an AC voltage or current for producing the oscillating electrical field. For completeness it is noted that “oscillating” may refer to sine waves, square waves, triangular waves, etc.

According to a possible embodiment the discharger is a corona. The developing roller is typically biased at a voltage between 200 V and 600 V. When only a DC bias is applied, the applied voltage on the corona is preferably in a range between -2 kV and -8 kV, more preferably between -3,5 kV and -5 kV. When applying an AC voltage, the AC voltage may have e.g. a DC component in a range between +1kV and -1,5 kV, preferably between -300 V and -500 V; a frequency in a range between 500 Hz and 5 kHz, preferably between 1 kHz and 2 kHz; and an amplitude in a range between 1 kV and 8 kV, preferably between 3 kV and 5 kV. Alternatively the corona may be biased with a DC and/or AC current. The current may be regulated e.g. in a range between 50 μA and 1 mA. As the charging behavior is less sensitive to current changes compared to voltage changes, adjusting the current instead of the voltage will make controlling the residual charge of the liquid toner easier.

The downstream discharger is typically a corona discharger, but may also be a discharge roller or a discharge blade, or a combination thereof. In case of a discharge roller, the voltage difference to be applied between the developing roller and the discharge roller will be dependent on the thickness of the liquid layer. In case of a discharge blade, the voltage difference to be applied between the developing roller and the discharge blade will be dependent on the thickness of the liquid layer and the thickness of the insulating layer surrounding the electrode included in the blade. A suitable value for the voltage difference would typically be larger than 100 V.

In an embodiment of the digital printing apparatus according to the present invention, the downstream discharger and the sensor are arranged opposite to a surface of said developing roller. Also the upstream charger is typically arranged opposite to a surface of said developing roller.

In a further embodiment, there are provided developing roller cleaning means. The downstream discharger is then preferably located upstream of the area of rotational contact between the developing roller and the developing roller cleaning means. In a particular embodiment, a cleaning roller is arranged in rotational contact with the developing roller. In that case, the downstream discharger and/or the sensor may also be arranged opposite to a surface of the cleaning roller.

The sensor may e.g. be an electrostatic voltage sensor or an optical density sensor. If an optical density sensor is used, the sensor is preferably located downstream of the liquid toner residue cleaning means. In that way, the

density will be a measure for the cleaning performance, and thus also a measure for the discharging performance. In other words, the optical density is also a property which is representative for the charge of the liquid toner.

In an embodiment of the digital printing apparatus according to the present invention, the upstream charger applies positive charges to said surface of the developing roller, and the downstream discharger applies negative charges to the surface of the developing roller.

These and other features and advantages of embodiments of the invention will now be described in relation to the attached drawings, in which:

Figure 1 schematically illustrates a digital printing apparatus according to a first embodiment;
Figure 2 schematically illustrates a digital printing apparatus according to a second embodiment including a cleaning roller;
Figure 3 schematically illustrates a digital printing apparatus according to a third embodiment including a squeegee roller;
Figure 4 schematically illustrates a digital printing apparatus according to a fourth embodiment including a discharge roller;
Figure 5 schematically illustrates a digital printing apparatus according to a fifth embodiment including a discharge blade;
Figure 6 schematically illustrates a digital printing apparatus according to a sixth embodiment;

Figure 7 schematically illustrates a digital printing apparatus according to a seventh embodiment implemented using an open loop control system;

Figure 8 is a graph illustrating the charging with a negative corona discharger compared to the charging with a positive corona charger in function of the applied bias voltage;

Figure 9 is a graph illustrating the evolution of the toner charge in function of an applied DC bias on the corona discharger; and

Figure 10 illustrates a graph of the optical density measured downstream of a scraper, in function of the toner charge.

Generally, a digital printing apparatus comprises a feed roller **104**, a developing roller **102**, and an image carrying roller **101**. The feed roller **104** is arranged to transfer a quantity of liquid toner **107** from a reservoir **106** onto the developing roller **102**; and the developing roller **102** is arranged to transfer a portion of said quantity of liquid toner **107** onto the image carrying roller **101** in accordance with a charge pattern sustained on a surface of the image carrying roller **101**. Reference is made to the aforementioned citations for further details about the operation of digital printing apparatus of this kind.

A first embodiment of a digital printing apparatus of the invention is illustrated in figure 1. In this embodiment an upstream corona charger **111** is arranged opposite to a surface of the developing roller **102** downstream of the area of its rotational contact with the feed roller **104** and upstream of the area **108** of its rotational contact with the image carrying roller **101**. Also, a downstream corona

discharger **112** is arranged downstream of the area **108** of rotational contact between said developing roller **102** and said image carrying roller **101** and upstream of the area of rotational contact between said developing roller **102** and a developing roller cleaning means, here in the form of a scraper **113.** In a typical arrangement, the upstream corona charger **111** applies positive charges to the surface of the developing roller **102**, and the downstream corona discharger **112** applies negative charges to the surface of the developing roller **102.**

A sensor **200** is arranged downstream of the downstream corona discharger **112**, and is adapted to detect a residual charge of a liquid toner residue, *i.e.* the toner that remains on the developing roller **102** after its contact with the image carrying roller **101.** An example of a suitable sensor is an electrostatic voltage sensor.

The digital printing apparatus further comprises a controller **210** arranged to receive sensor data from the sensor **200** and to provide a control signal to control the downstream corona discharger **112.** The controller **210** is configured to control the corona discharger such that the residual charge of the liquid toner residue is within a predetermined range. According to a possible embodiment, the controller is configured to minimize the absolute value of the residual charge. In other words, the controller **210** calculates the operational parameters for the downstream corona discharger **112** that are expected to minimize the difference between a measured value for the charge and a target value. In particular, the target value may be the sensor value that corresponds, after calibration, to electric neutrality at the level of the toner particles.

The developing roller **102** is typically biased at a voltage between 200V and 600 V. The downstream corona discharger **112** may produce either a DC electric field or an AC electric field. If a DC electric field is applied, the applied DC voltage is typically in a range between -2 kV and -8 kV, preferably between -3,5 kV and -5 kV. If the downstream corona discharger **112** is configured for producing an AC electric field, the following values may be used:

- a DC voltage of + 1 kV to -1,5 kV typically between -300 V and -500 V;
- an AC rms voltage between 1 kV and 8 kV, typically between 3 kV and 5 kV;
- a frequency between 500 Hz and 5 kHz, typically between 1 kHz and 2 kHz.

The applied DC voltage on the corona charger **111** is typically in a range between 2 kV and 8 kV, preferably between 3,5 kV and 5 kV.

Alternatively the corona charger **111** and/or discharger **112** may be biased with a DC and/or AC current may. The DC current of the corona discharger **112** may be regulated e.g. in a range between 50 μA and 1 mA. As the charging behavior is less sensitive to current changes compared to voltage changes, adjusting the current instead of the voltage will make controlling the residual charge of the liquid toner easier.

Suitable values for the DC and/or AC voltage or current applied on the downstream corona discharger **112** will typically depend on a large number of parameters such as the

process speed, the toner parameters, the device geometry, the initial toner charge voltage, etc.

Typically a number of alternations of the oscillating electric field will be necessary for obtaining an appropriate decompacting of the liquid toner residue. The number of alternations that the liquid toner residue is subjected to when passing the downstream corona discharger is dependent on the process speed and the AC frequency of the AC signal. This is illustrated in the table below for a 15 mm corona.

Number of alternations for given process speed and AC frequency (corona 15 mm)			
	1 m/s	**2 m/s**	**3 m/s**
500 Hz	7,5	3,25	2,5
1 kHz	15	7,5	5
2 kHz	30	15	10

Depending on the toner parameters, for a process speed of 1m/s, e.g. 15 alternations may be sufficient, in which case a frequency of 1 kHz could be used. In other words, for a fixed process speed, the number of alternations applied on an imaging particle passing the corona discharger may be varied by varying the AC frequency. In that way the decompacting of the liquid toner residue can be controlled in an improved way.

In the variant of Figure 1, the downstream corona discharger **112** and the sensor **200** are arranged opposite to a surface of the developing roller **102.**

In the embodiment of Figure 2, the developing roller cleaning means comprises a cleaning roller **105** arranged in rotational contact with the developing roller **102,** and a scraper **114.** The downstream corona discharger **112** and the

sensor **200** are arranged opposite to a surface of the cleaning roller **105.** According to a non-illustrated variant of the embodiment of figure 2, the sensor **200** and corona discharger **112** could be arranged opposite to a surface of the developing roller **102,** or the sensor could be arranged opposite to a surface of the cleaning roller **105,** while the corona discharger **112** is arranged opposite to a surface of the developing roller **102.**

According to a third variant illustrated in figure 3, the cleaning roller **105** could be a squeegee roller. In the illustrated example the sensor **200** is located opposite to the cleaning roller **105,** while the downstream corona discharger **112** is located opposite to the developing roller **102.** The skilled person understands that according to a variant, both the sensor **200** and the corona discharger **112** could be located opposite to the squeegee roller **105,** or alternatively opposite to the developing roller **102.**

A fourth variant is illustrated in figure 4. In this embodiment, the corona discharger **112** is replaced with a discharge roller **122.** According to yet another non-illustrated embodiment, the corona discharger **112** could be combined with a discharge roller **122.**

A fifth variant of the invention is illustrated in figure 5. In this embodiment, the corona discharger is replaced with a discharge blade **132.** Again, the skilled person understands that this discharge blade **132** could be combined with a corona discharger **112** and/or discharge roller **122.**

Figure 6 illustrates a sixth variant which is similar to the variant of figure 1, with this difference that the sensor

has been placed downstream of the scraper **113**. In this embodiment, the sensor may be an optical density sensor. Indeed, the density of the liquid toner remaining on the developing roller **102** after having passed the scraper **113** is a measure for the cleaning performance of the scraper **113**. In turn, the cleaning performance is a measure for the discharge performance and hence a measure for the charge of the liquid toner remaining on the developing roller downstream of the corona discharger **112**. The graph of Figure 10 illustrates the relationship between the optical density and the toner charge. From this graph it can be derived that the optical density is a property of the liquid toner which is representative for the toner charge.

Considering the variant of Figure 6, the skilled person understands that also for the embodiments of Figures 1, 2, 4 and 5, the sensor **200** could be an optical density sensor and could be placed after the scraper **113** for the embodiments of Figures 1, 4 and 5, or after the scraper **114** for the embodiment of Figure 2.

Figure 7 illustrates a seventh variant implementing an open-loop system instead of a closed-loop system. In this embodiment, the sensor **200** is placed upstream of the corona discharger **112**.

Embodiments of the invention are based on the insight of the inventors that charging and discharging behavior is not identical. This is illustrated in the graph of Figure 8, which shows the absolute value of the positive and negative charge versus the absolute value of the applied positive and negative bias voltage on the corona charger and discharger, respectively, for a test configuration with a first member

biased at 0 V. As shown in Figure 8, for the toner under test, the negative charge raises faster with the applied DC bias compared to the positive charge. In view of the sharp raising edge of the negative charge with the applied corona voltage, controlling that voltage becomes critical. The skilled person understands that the graph of Figure 8 is merely an example for a particular type of toner, and that the curves may be substantially different for other liquid toners and/or coronas. E.g. for certain other toners the charging curve could raise faster than the discharging curve. Further, the behavior of the charging and discharging will be dependent on the process speed, the toner parameters, the geometry, the charge pattern on the image carrying roller, etc.

Taking into account the considerations above, the proposed closed-loop of embodiments of the invention may significantly improve the operation of the display apparatus. Although an open-loop system as illustrated in figure 7 is an improvement over the prior art, the closed-loop system illustrated in figures 1-6 leads to an even more significant improvement.

Because the discharging curve in the graph of Figure 8 is more edgy than the charging curve, even a true AC corona discharger (with a zero bias voltage) may discharge the positive potential on the liquid toner residue and may even create a further negative charge when the AC RMS value is sufficiently large.

Figure 9 illustrates the charge voltage of a liquid toner residue in function of a DC bias voltage of the corona discharger. Starting off with a 20 V charge level, the graph

shows a very steep slope for discharging. Tests have been done on two different test fixtures using both fresh toner and seriously abused toner. Those tests show the same slope and discharge values. This graph further illustrates that a control of the downstream discharger **112, 122, 132** in the embodiments discussed above, will significantly improve the operation of the display apparatus.

While the invention has been described hereinabove with reference to embodiments using positively charged toner particles and electric tensions or fields arranged to act on these positively charged toner particles, in particular to electrophoretically move them, a skilled person will immediately appreciate that the invention equally applies to embodiments using negatively charged toner particles. In the latter case, the polarity of the electric fields acting on the toner particles needs to be reversed, leading to a physically equivalent arrangement with the same technical effects. All voltage ranges mentioned in the present description with respect to embodiments operating with positively charged toner particles are hereby stated to also apply to corresponding embodiments operating with negatively charged toner particles, provided that the sign of the voltage values is changed.

Although the invention has been described hereinabove with reference to specific embodiments, this has been done to illustrate and not to limit the invention, the scope of which is to be determined on the basis of the appended claims.

Conclusies

1. Digitale drukinrichting omvattende een ontwikkelrol (102) en een beelddragende rol (101); welke ontwikkelrol (102) ingericht is om een gedeelte van een hoeveelheid vloeibare toner (107) over te dragen op de beelddragende rol (102) in overeenstemming met een ladingspatroon dat aangebracht is op een oppervlak van de beelddragende rol (101); waarbij een stroomopwaartse lader (111) aangebracht is stroomopwaarts van een rotatiecontactzone (108) tussen de ontwikkelrol (102) en de beelddragende rol (101); waarbij een stroomafwaartse ontlader (112, 122, 132) aangebracht is stroomafwaarts van de rotatiecontactzone (108); **met het kenmerk dat** de digitale drukinrichting verder omvat:
een sensor (200) die stroomafwaarts van de rotatiecontactzone (108) aangebracht is, welke sensor ingericht is om een eigenschap die respresentatief is voor de lading van een vloeibare tonerresidu te detecteren stroomafwaarts van de rotatiecontactzone (108); en
een regelaar (210) die ingericht is om sensordata te ontvangen van de sensor (200) en om een regelsignaal te verschaffen voor het regelen van de stroomafwaartse ontlader op basis van de ontvangen sensordata.

2. Digitale drukinrichting volgens conclusie 1, waarbij de sensor stroomafwaarts van de stroomafwaartse ontlader (112, 122, 132) aangebracht is.

3. Digitale drukinrichting volgens conclusie 1 of 2 waarbij de regelaar (210) geconfigureerd is om de ontlader zodanig te regelen dat een restlading van het vloeibare tonerresidu, op een locatie stroomafwaarts van de ontlader, binnen een vooraf bepaald bereik ligt.

4. Digitale drukinrichting volgens conclusie 3, waarbij de regelaar (210) geconfigureerd is om de absolute waarde van de restlading te minimaliseren.

5. Digitale drukinrichting volgens één der voorgaande conclusies, waarbij de stroomafwaartse ontlader (112, 122, 132) geconfigureerd is om een elektrisch veld te produceren in het vloeibaar tonerresidu, en waarbij het regelsignaal betrekking heeft op tenminste een van een DC instelspanning of een DC instelstroom die aangelegd wordt voor het produceren van het elektrisch veld.

6. Digitale drukinrichting volgens conclusie 5, waarbij de ontlader een corona is; waarbij de absolute waarde van een spanningsverschil tussen de ontladingscorona en de ontwikkelrol in een bereik ligt tussen 2 kV en 8 kV, bij voorkeur tussen 3,5 en 5,5 kV.

7. Digitale drukinrichting volgens een der voorgaande conclusies waarbij de stroomafwaartse ontlader (112, 122, 132) geconfigureerd is om een AC elektrisch veld te produceren, en waarbij het controlesignaal betrekking heeft op tenminste een van een DC instelspanning of stroom, een frequentie, en een amplitude van AC spanning of stroom voor het produceren van het AC elektrisch veld.

8. Digitale drukinrichting volgens conclusie 7, waarbij de ontlader een corona is; waarbij de frequentie in een bereik ligt tussen 500 Hz en 5 kHz, bij voorkeur tussen 1 Hz en 2 kHz; en/of de amplitude in een bereik ligt tussen 1 kV en 8 kV, bij voorkeur tussen 3 kV en 5 kV.

9. Digitale drukinrichting volgens één der voorgaande conclusies, waarbij de stroomafwaartse ontlader een van de volgende is: een coronaontlader (112), een ontlaadrol (122), een ontlaadmes (102), of een combinatie daarvan.

10. Digitale drukinrichting volgens een der voorgaande conclusies, verder omvattende een toevoerrol (104), welke toevoerrol (104) ingericht is om een hoeveelheid vloeibare toner over te brengen vanaf een reservoir (106) naar de ontwikkelrol (102); waarbij de stroomopwaartse lader (111) stroomafwaarts van de rotatiecontactzone, tussen de ontwikkelrol en de toevoerrol (104), gelegen is.

11. Digitale drukinrichting volgens één der voorgaande conclusies, verder omvattende een ontwikkelrol reinigingsmiddel (113); waarbij de stroomafwaartse ontlader stroomopwaarts van de rotatiecontactzone tussen de ontwikkelrol (102) en het ontwikkelrolreinigingsmiddel (113)gelegen is.

12. Digitale drukinrichting volgens één der voorgaande conclusies, waarbij de stroomafwaartse ontlader (112, 122, 132) en de sensor (200) aangebracht zijn tegenover een oppervlak van de ontwikkelrol; en/of waarbij de stroomopwaartse lader aangebracht is tegenover een oppervlak van de ontwikkelrol.

13. Digitale drukinrichting volgens één der conclusies 1 tot 9, waarbij een reinigingsrol (105) in rotatiecontact met de ontwikkelrol aangebracht is, en waarbij de stroomafwaartse ontlader en/of de sensor tegenover een oppervlak van de reinigingsrol aangebracht zijn.

14. Digitale drukinrichting volgens één der voorgaande conclusies, waarbij de sensor (220) een elektrostatische spanningssensor of een optische dichtheidssensor is.

15. Digitale drukinrichting volgens een der voorgaande conclusies, omvattende reinigingsmiddelen (113, 114) van een vloeibaar tonerresidu, waarbij de sensor (200) een optische dichtheidssensor is die stroomafwaarts van de reinigingsmiddelen van het vloeibaar tonerresidu aangebracht is.

16. Digitale drukinrichting volgens één der voorgaande conclusies, waarbij de stroomopwaartse lader positieve ladingen aanbrengt op het oppervlak van de ontwikkelrol, en waarbij de stroomafwaartse ontlader negatieve ladingen aanbrengt op het oppervlak van de ontwikkelrol.

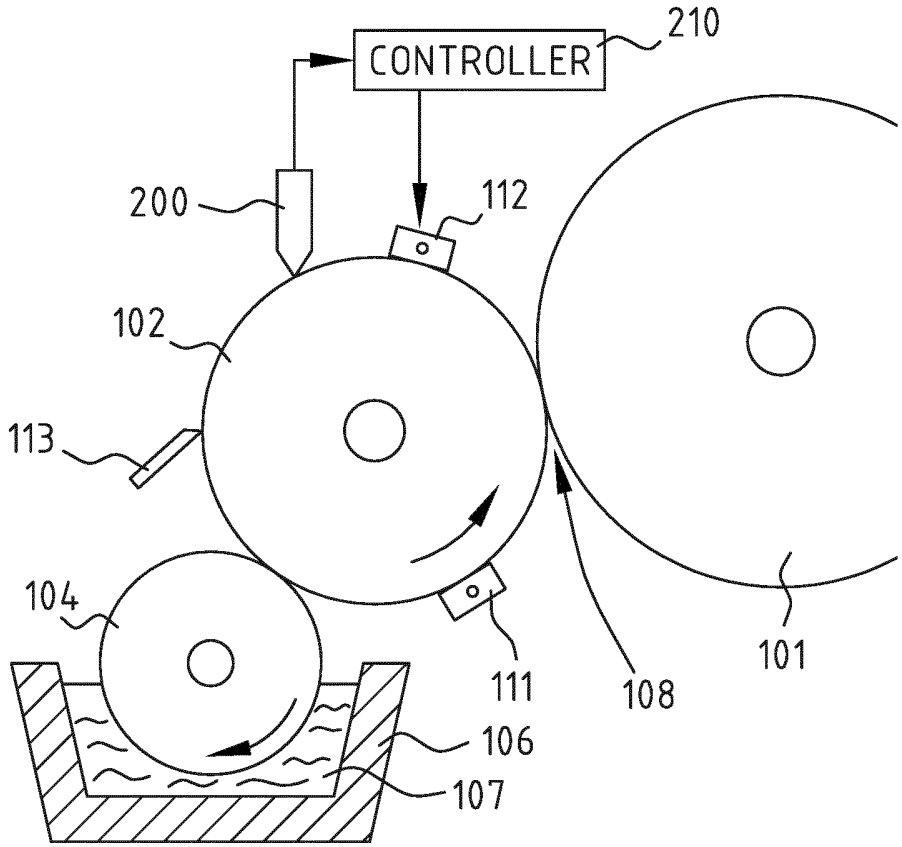

CONTROLLER
210
200
112
102
113
104
111
108
101
106
107

FIG. 1

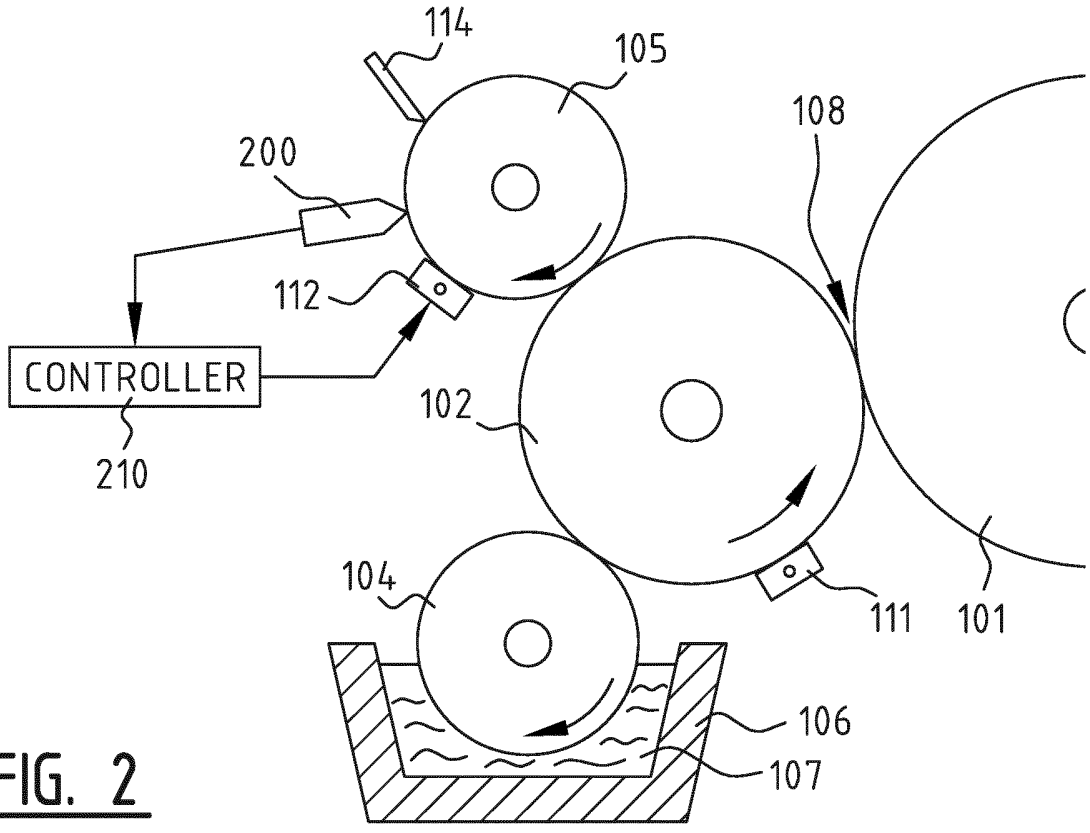

114
105
108
200
112
CONTROLLER
210
102
104
111
101
106
107

FIG. 2

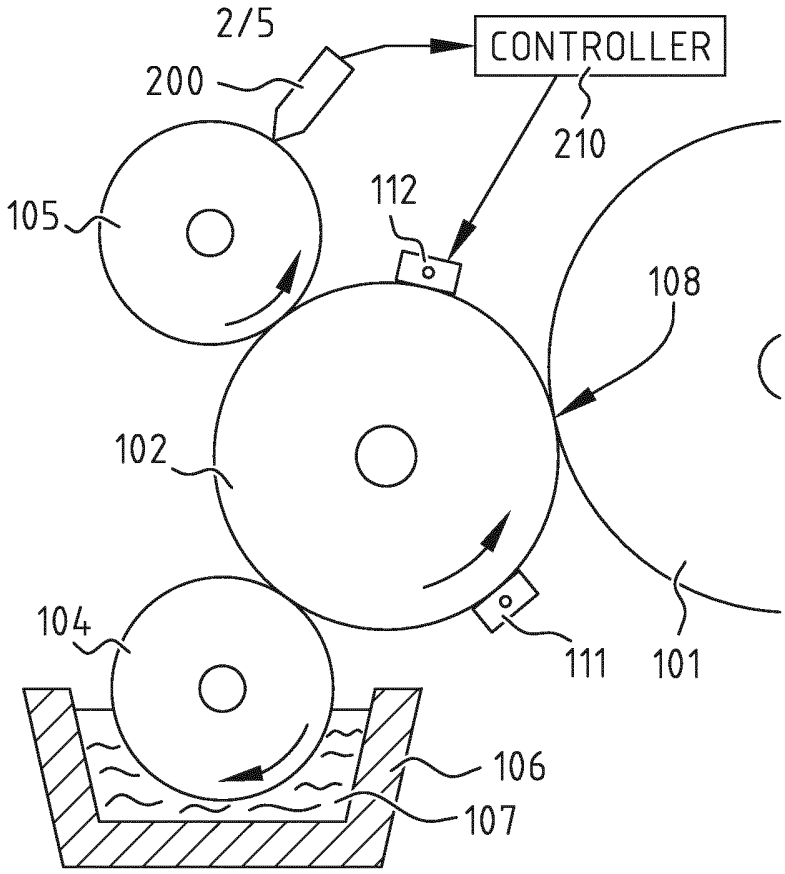

CONTROLLER
210
200
105
112
108
102
104
111
101
106
107

FIG. 3

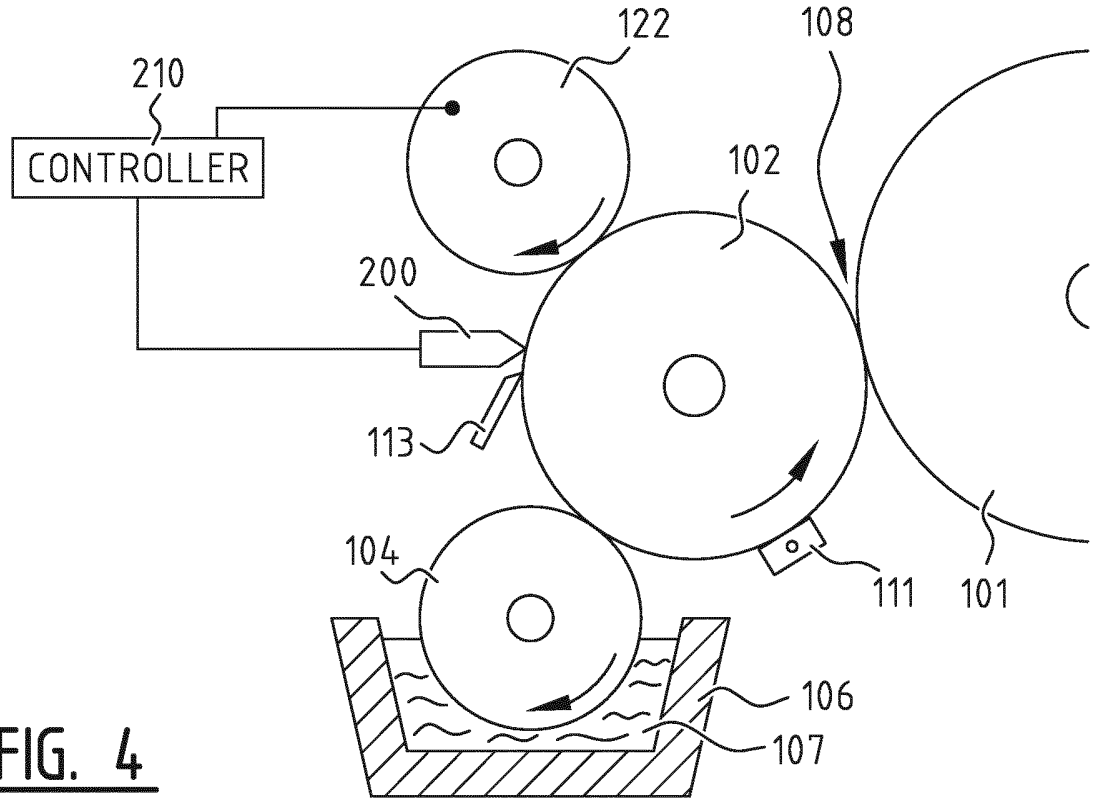

122
108
210
CONTROLLER
102
200
113
104
111
101
106
107

FIG. 4

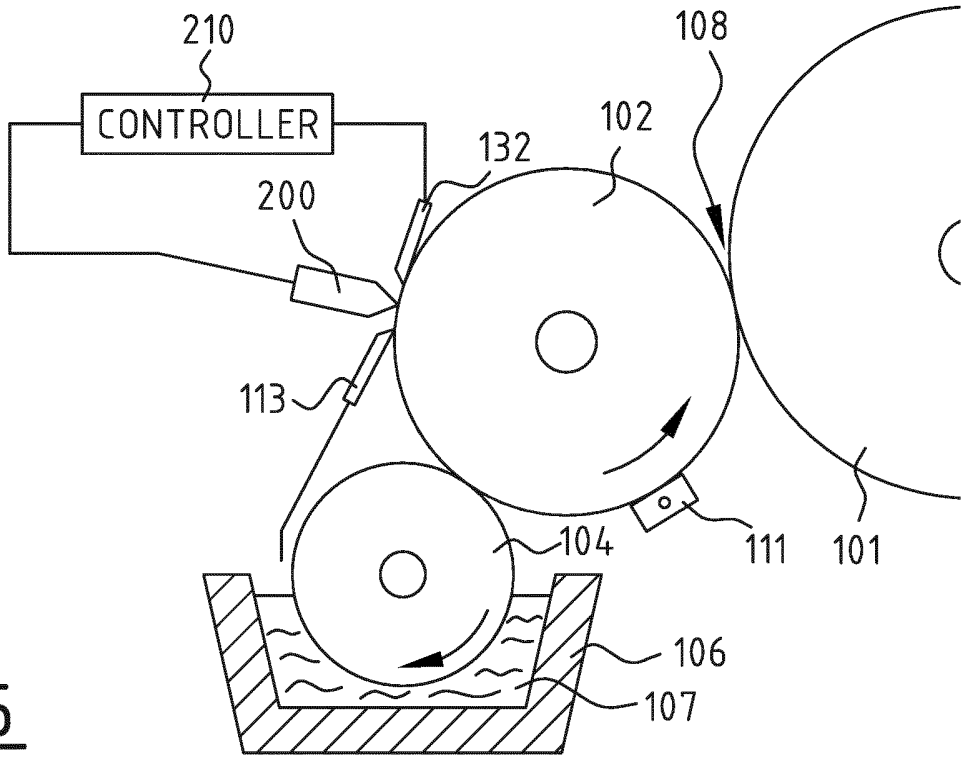

210
CONTROLLER
108
102
132
200
113
104
111
101
106
107

FIG. 5

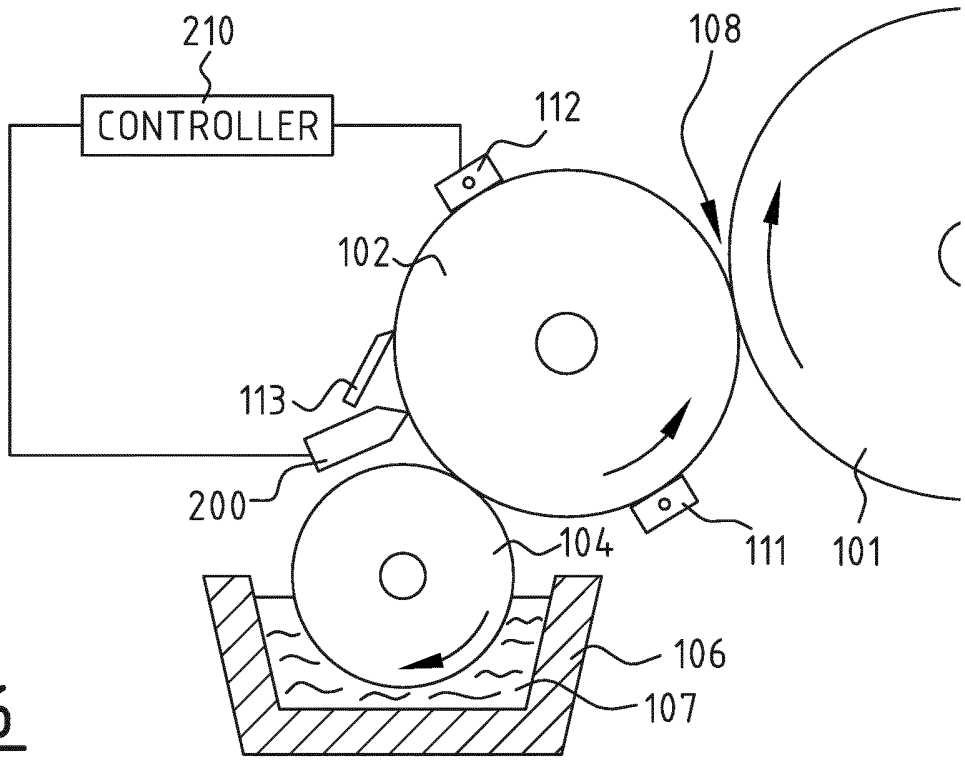

210
CONTROLLER
108
112
102
113
200
104
111
101
106
107

FIG. 6

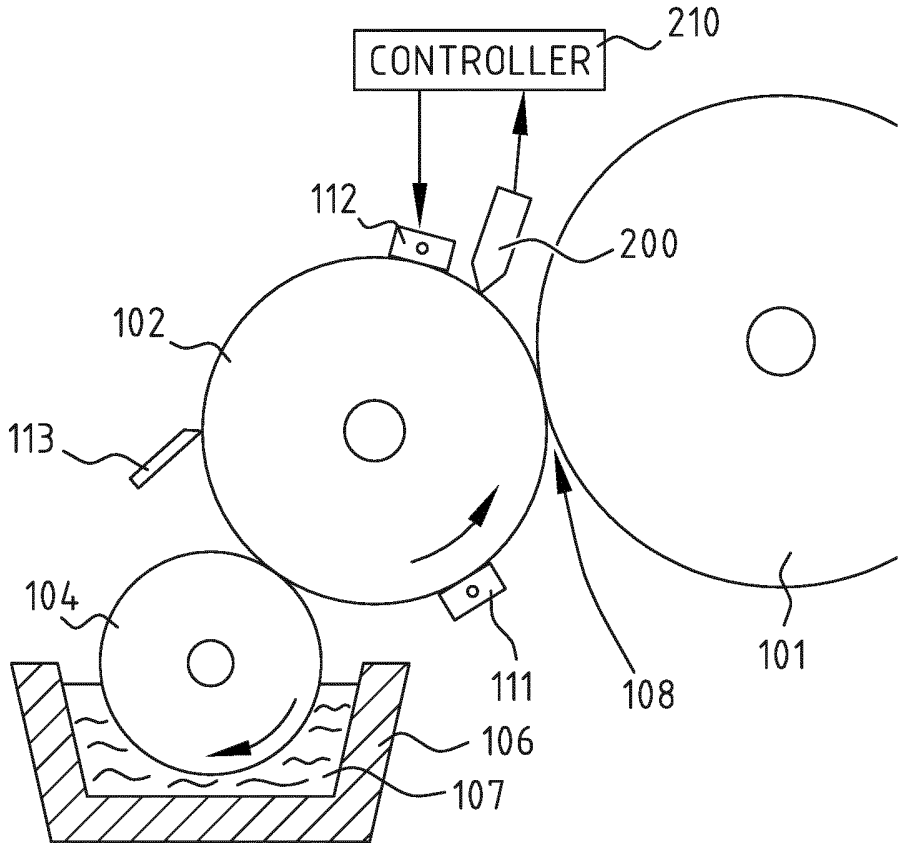

CONTROLLER
210
112
200
102
113
104
111
108
101
106
107

FIG. 7

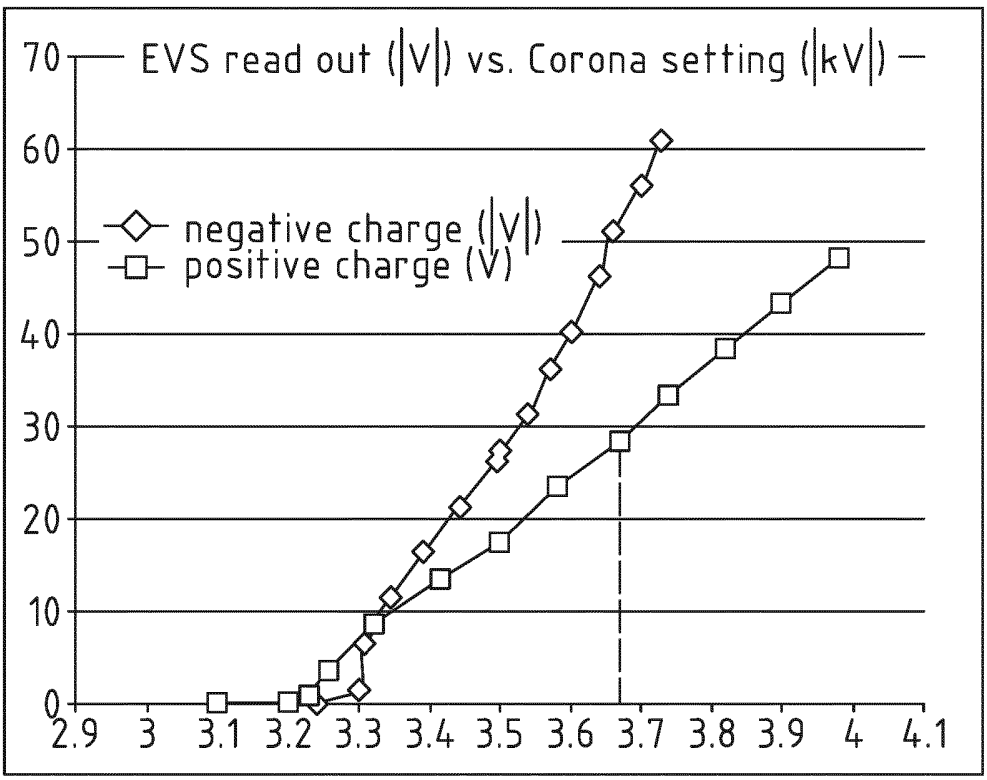

EVS read out (|V|) vs. Corona setting (|kV|)
negative charge (|V|)
positive charge (V)
70
60
50
40
30
20
10
0
2.9
3
3.1
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4
4.1

FIG. 8

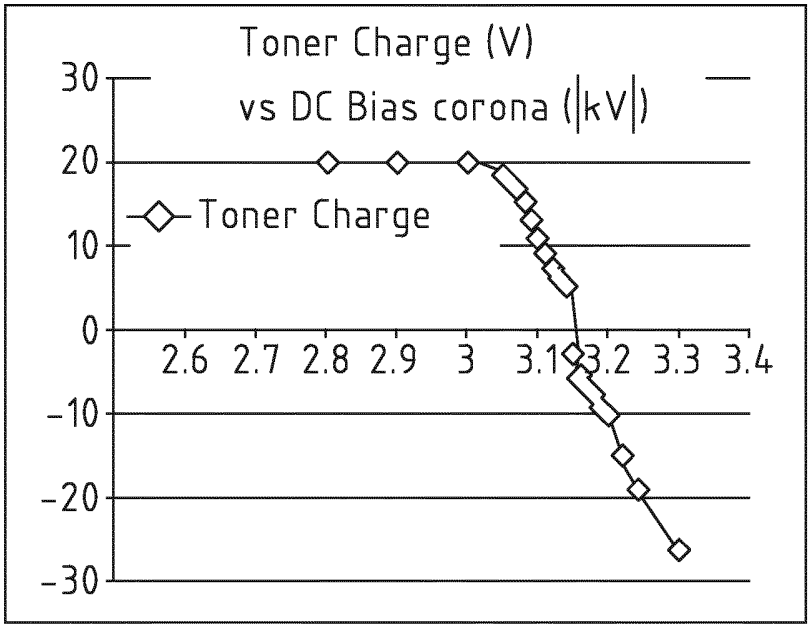

Toner Charge (V)
vs DC Bias corona (|kV|)
Toner Charge
30
20
10
0
-10
-20
-30
2.6
2.7
2.8
2.9
3
3.1
3.2
3.3
3.4

FIG. 9

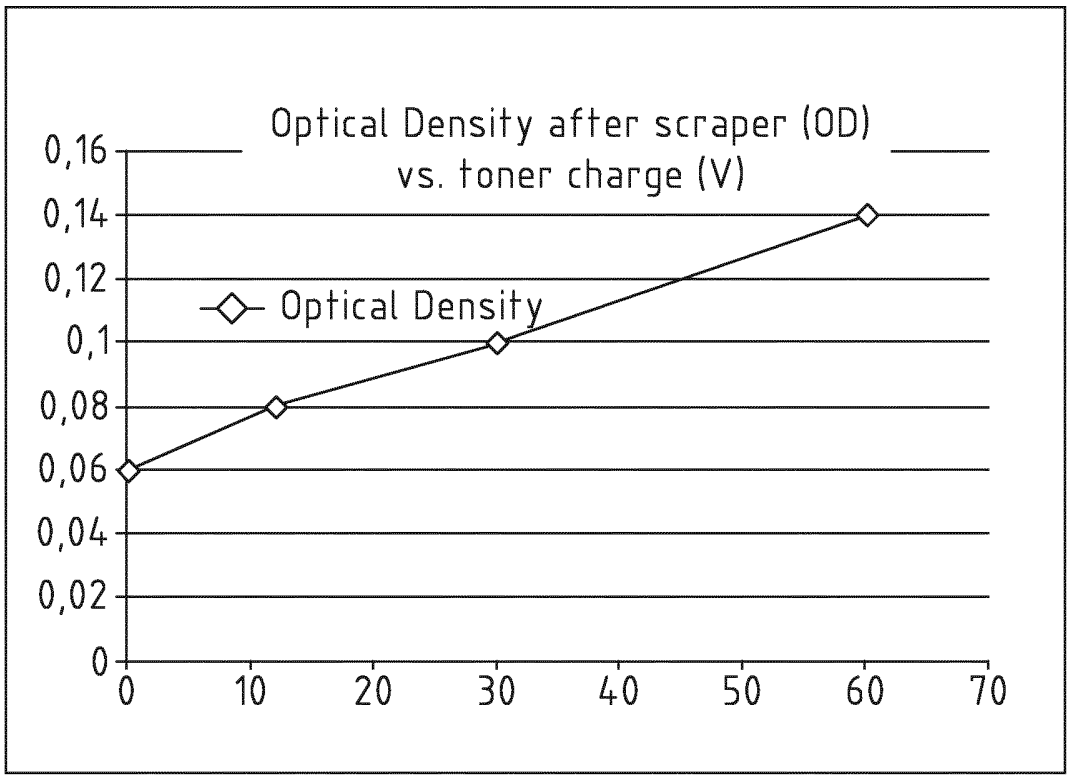

Optical Density after scraper (OD)
vs. toner charge (V)
Optical Density
0,16
0,14
0,12
0,1
0,08
0,06
0,04
0,02
0
0
10
20
30
40
50
60
70

FIG. 10

SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	2H/2NQ81/KM/7
Nederlands aanvraag nr. **2010573**	Indieningsdatum **05-04-2013**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Xeikon IP B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **15-06-2013**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN 60247**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

G03G15/11

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC8	**G03G**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐ **GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐ **GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2010573

A. CLASSIFICATIE VAN HET ONDERWERP
INV. G03G15/11
ADD.

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
G03G

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
Y	US 2010/040387 A1 (HIRAI ATSUTO [JP]) 18 februari 2010 (2010-02-18) * alineas [0013], [0014], [0089], [0097], [0098], [0115], [0234]; conclusies; figuren 1,11; tabel 1 *	1-16
Y	US 2012/237237 A1 (HIRAI ATSUTO [JP]) 20 september 2012 (2012-09-20) * alineas [0012], [0013], [0016], [0057], [0062]; figuur 1 *	1-16
A	US 2011/274466 A1 (IZAWA HIDEO [JP] ET AL) 10 november 2011 (2011-11-10) * alineas [0024] - [0026]; figuur 1 *	1-16

☐ Verdere documenten worden vermeld in het vervolg van vak C.

☒ Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
29 november 2013	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Lipp, Günter

Formulier PCT/ISA/201 (tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2010573

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 2010040387 A1	18-02-2010	JP 2010044189 A	25-02-2010
		US 2010040387 A1	18-02-2010
US 2012237237 A1	20-09-2012	JP 2012198300 A	18-10-2012
		US 2012237237 A1	20-09-2012
US 2011274466 A1	10-11-2011	CA 2738342 A1	07-11-2011
		CN 102236304 A	09-11-2011
		EP 2385431 A2	09-11-2011
		JP 2011237514 A	24-11-2011
		US 2011274466 A1	10-11-2011

OCTROOICENTRUM NEDERLAND

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN60247	05.04.2013		NL2010573

International Patent Classification (IPC)
INV. G03G15/11

Applicant
Xeikon IP B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the application
- ☒ Box No. VIII Certain observations on the application

	Examiner
	Lipp, Günter

Application number

WRITTEN OPINION

NL2010573

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	1-16
	No:	Claims	
Inventive step	Yes:	Claims	
	No:	Claims	1-16
Industrial applicability	Yes:	Claims	1-16
	No:	Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Box No. VIII Certain observations on the application

see separate sheet

Box No. V

Reasoned statement on novelty, inventive step and industrial applicability

1 **[Comments on prior art cited in the search report]**

1.1 D1 = US 2010040387 A discloses a wet type electrophotographic printer comprising a liquid developer removing unit removing residual liquid developer from the surface of the developing roller. The liquid development unit comprises a upstream pre-transfer charger 42 and a downstream post-transfer discharger 43 at the developing nip between developing roller and photodrum. The charging charger 42 and a discharging charger 43 are controlled by control unit CPU with variable output currents on upstream and downstream with respect a developing area in a moving direction of the roller. The device controls the output of the discharging charger corresponding to the output of the charging charger, so that cleaning of the developer left on the developing roller can be satisfactorily carried out by using a blade 46, thus ensuring effective cleaning.Since the charging amount of toner is changed by controlling the output of the charging charger 42, the charging amount is implicitly known. The output of the discharging charger 43 is then accordingly changed to keep the ability of cleaning the developer remaining after the development. Table 1 shows experimental results between adhered toner amount, charging output = toner charging amount and required discharging output having particular cleaning performance. See fig.1,11, par. 13,14,89,97,98,115,234, table 1, claims.

1.2 D2 = US 2012237237 A discloses a wet-type image forming apparatus, wherein a surface potential sensor 28 for measuring member is used for measuring a potential of the liquid developer on a developing roll 24 charged by the charger 26 and is provided upstream of developing nip but downstream of the charger 26. The sensor is used to adjust the toner charge appropriately for an efficient transfer onto the photodrum. A cleaning blade 25 for removing undeveloped remaining liquid toner from the developing roller 24 downstream of developing nip. See fig. 1, par. 12,13,16,57,62.

1.3 D3 = US 2011274466 A discloses a wet type developing apparatus with plural cleaning blades. It comprises a liquid developer removing unit removing residual liquid developer from the surface of the developing roller. A pre-transfer charger 14 and post-transfer discharger 13 is provided upstream and downstream of the developing nip. The toner particles are recovered efficiently and the occurrence of the caking phenomenon is prevented. See fig. 1, par. 24-26.

2 **[Independent claim]**

2.1 The subject-matter of independent claim 1 appears novel in the view of cited documents D1 to D3 and is industrial applicable.

2.2 The subject-matter of claim 1 does involve an inventive step as will be shown in the following.

2.2.1 Document D1 discloses the following features of claims 1, the reference sign are with respect to figs. 10,11 of D1: Digitale drukinrichting omvattende een ontwikkelrol (41) en een beelddragende rol (1); welke ontwikkelrol (41) ingericht is om een gedeelte van een hoeveelheid vloeibare toner (8) over te dragen op de beelddragende rol (1) in overeenstemming met een ladingspatroon dat aangebracht is op een oppervlak van de beelddragende rol (1); waarbij een stroomopwaartse lader (42) aangebracht is stroomopwaarts van een rotatiecontactzone () tussen de ontwikkelrol (41) en de beelddragende rol (1); waarbij een stroomafwaartse ontlader (43) aangebracht is stroomafwaarts van de rotatiecontactzone ().

2.3 When referrring to the above discussion of prior art D1 further discloses a control unit (CPU = regelaar) which is configured "om een regelsignaal te verschaffen voor het regelen van de stroomafwaartse ontlader". Following par. 234 of D1 it is concluded that since the charging amount of toner is changed controlling the output of the charging charger 42, the charging amount is implicitly known to the CPU and the downstream discharger 43 is thus controlled with respect to paramter similar to the claimed feature: "op de basis van een eigenschap die representatief is voor de lading van een vloeibare tonerresidu". There is hence clearly disclosed the a relation between the charging amount and the cleaning of residual liquid developer, see also table 1 of D1.

2.4 When claim 1 is read in a clarified form as indicated below, D1 does not disclose the sensor feature, namely a "een sensor die stroomafwaarts van de rotatiecontactzone aangebracht is, welke sensor ingericht is om een eigenschap die representatief is voor de lading van een vloeibare tonerresidu te detecteren stroomafwaarts van de rotatiecontactzone"

2.5 This feature is directed to the solve the problem of using correct charging amount data of the residual toner to appropriately control the discharger. The normal and straightforward solution is simply to use a sensor for the determination of the actual charging amount. Sensors of such type are widely known and used. In D2 e.g. the output of sensor 28 is directed to control the charging means 26 (both showb in fig. 1 of D2) for an efficient transfer.

2.6 A skilled person would obviously think of using a sensor to determine the correct charging amount of untransferred liquid toner downstream the developing nip in order to control the discharger known from D1. Thereby he automatically arrives at the subject-matter of claim 1.

3 **[Dependent claims]**

3.1 The dependent claim do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements with respect to novelty and/or inventive step.

3.2 The features defined by the claims are merely part of the commonly known prior art in the field and as such part of the normal technical expertise of the skilled person. The dependent claims define only constructional details of how to arrange and design the different charging and cleaning means around the developing roller. Particularly this is seen as normal duty of the skilled person.

3.3 The reasons will be apparent from the following:

3.3.1 claim 2: de sensor stroomafwaarts van de stroomafwaartse ontlader, see D2, fig. 1;

3.3.2 claim 3: restlading binnen een vooraf bepaald bereik

3.3.3 claim 4: absolute waarde van de restlading minimaliseert

3.3.4 claim 5: regelsignaal: DC instelspanning of een DC instelstroom voor het produceren van het elektrisch veld, there are several known possibilites to generate the electrical field usign AC and DC, depend on the actual needs;

3.3.5 claim 6: absolute waarde van een spanningsverschil tussen de ontladingscorona en de ontwikkelrol, depends on the kind of toner used;

3.3.6 claim 7: controlesignaal: DC instelspanning of stroom, een frequentie en een amplitude van AC spanning of stroom voor het AC elektrisch veld, there are several known possibilites to generate the electrical field usign AC and DC, depend on the actual needs;

3.3.7 claim 8: AC frequentie en spanning, depends on the kind of toner used;

3.3.8 claim 9: coronaontlader, ontlaadrol, ontlaadmes, see D1,D2;

3.3.9 claim 10: lader ontwikkelrol en de toevoerrol, see D1. fig. 11;

3.3.10 claim 11: ontlader tussen de ontwikkelrol en het ontwikkelrolreinigingsmiddel, see D1, fig. 11;

3.3.11 claim 12: ontlader,lader en sensor tegenover van de ontwikkelrol, see D2, fig. 1;

3.3.12 claim 13: ontlader, sensor tegenover een reinigingsrol, see D1,D2;

3.3.13 claim 14: elektrostatische spanningssensor, see d2; optische dichtheidssensor, unclear feature;

3.3.14 claim 15: optische dichtheidssensor stroomafwaarts van de reinigingsmiddelen, unclear feature;

3.3.15 claim 16: stroomopwaartse lader positieve ladingen, stroomafwaartse ontlader negatieve ladingen, depends on the kind of toner used;

Box No. VIII

Certain observations on the application (clarity)

4 **[Independent claim]**

4.1 Some features of claim 1 are not correctly defined, probably due to a confusion between "regelaar (210)" and "sensor (200)".

4.2 Apparently the sensor (sensor 200) should be configured to a measurement and the control unit (regelaar 200) should be configured to receive a measurement signal and not the other way around as defined by the claims.

5 **[Dependent claims]**

5.1 Claim 10: A feature of the claim should apparently be read as "stroomopwaartse lader (111) stroomopwaarts van de rotatiecontactzone" and not "stroomafwaarts". Similar applies for claim 11.

5.2 Claim 14: It is not per se clear how an optical density can generate a signal for the charging amount of a residual toner layer, as claimed in claim 1.

6 The terms relating to the position, i.e. the terms "stroomopwaarts" and "stroomafwaarts" with respect to the developing nip, the cleaning and the supply roll should be revised and drafted correctly.