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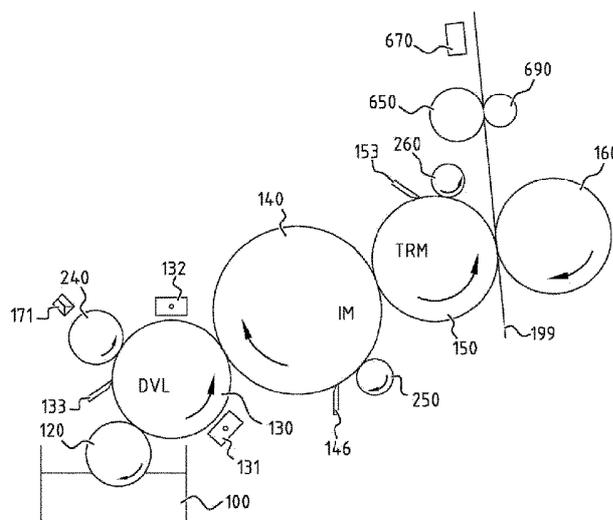
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54 **Digital printing apparatus and printing process.**

57 The digital printing apparatus uses a liquid toner comprising toner particles in a carrier liquid for printing an image on a substrate. It comprises an imaging member (140) adapted to sustain a pattern of electric charge forming a latent image on its surface; a development member (130) arranged to receive a quantity of the liquid toner dispersion and to develop said latent image; means for transfer (150, 160) of the liquid toner dispersion from the imaging member (140) to the substrate (199) at a transfer location, and a fusing unit (670). The apparatus further comprises a liquid removal unit (650) arranged for removal of carrier liquid from the substrate (199), and upstream of said fusing unit (670).



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Dit octrooi is verleend ongeacht het bijgevoegde resultaat van het onderzoek naar de stand van de techniek en schriftelijke opinie. Het octrooischrift wijkt af van de oorspronkelijk ingediende stukken. Alle ingediende stukken kunnen bij Octrooi Centrum Nederland worden ingezien.

## Digital printing apparatus and printing process

### FIELD OF THE INVENTION

- 5 The invention relates to a digital printing apparatus using a liquid toner comprising toner particles in a carrier liquid for printing an image on a substrate, which apparatus comprises:
- a development member arranged to receive a quantity of the liquid toner and provided with means for charging said liquid toner
  - an imaging member arranged in contact with said development member so as to receive the
  - 10 charged liquid toner under the impact of an electric field from the development member according to a pattern of electric charge forming a latent image on the imaging member
  - means for transfer of the liquid toner from the imaging member to the substrate at a transfer location, and
  - a fusing unit for fusing of the liquid toner into the image on the substrate,
- 15 The invention further relates to a digital printing process comprising the steps of applying the said liquid toner dispersion on the development member, charging said liquid toner dispersion, transferring the charged liquid toner dispersion patternwise to the imaging member and thereafter to a substrate, and fusing the toner dispersion into the image.

### 20 BACKGROUND OF THE INVENTION

Digital printing apparatus using liquid toner dispersion – also known as liquid toner - are known from US patent application publication no. 2011/0249990. The known digital printing apparatus comprises a feed member, a development member, development member cleaning means, and an

25 image carrying member, these member being preferably rollers; the feed member being arranged to transfer a quantity of liquid toner from a toner container onto the toner member; and the development member being arranged to transfer a portion of the quantity of liquid toner onto the image carrying member in accordance with a charge pattern sustained on a surface of said image carrying member. A liquid toner residue, also referred to as an excess liquid toner, remains on (the

30 surface of) the development member after the imagewise transfer of the liquid toner from the development member to a further member, particularly the imaging member.

After transfer to the imaging member, the liquid toner dispersion is transferred to the substrate, either directly or via a further member. The liquid toner dispersion is thereafter fused in a fusing unit, resulting in a film according to a desired pattern, and hence an image on the substrate.

35 Fusing may be carried out in various manners and typically involves heating. One suitable manner is to start the fusing process with the use of non-contact fusing.

Fusing of the liquid toner is one of the sensitive steps in the digital printing process. This fusing is to result in coalescence of the toner particles on the substrate. Typically use is made of a heat treatment that takes place shortly before, during or shortly after the transfer of the dispersion to the substrate. The term ‘coalescence’ refers herein to the process wherein toner particles melt  
5 together and form a film or continuous phase that adheres well to the substrate and that is separated from any carrier liquid. Suitably, the carrier liquid is thereafter removed in a separate step, for instance by means of blowing off the carrier liquid, by means of suction. Suitably, this process occurs at “high speed”, for instance 50 cm/s or more, so as to enable high-speed printing. The fusing has to avoid formation of an emulsion, since an emulsion does not give a good printing  
10 image because film formation is omitted.

A particular issue resulting in misprints, is known as ghost fusing images. These are images that are different in colours and/or portions of the image being slightly shifted in gloss.

#### SUMMARY OF THE INVENTION

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It is therefore an object of the invention to provide an apparatus and a process which are less susceptible of generating ghost fusing images.

According to a first aspect, the invention relates to a digital printing apparatus using a liquid toner comprising toner particles in a carrier liquid for printing an image on a substrate, which apparatus  
20 comprises (1) a development member arranged to receive a quantity of the liquid toner and provided with means for charging said liquid toner; (2) an imaging member arranged in contact with said development member so as to receive the charged liquid toner under the impact of an electric field from the development member according to a pattern of electric charge forming a latent image on the imaging member; (3) means for transfer of the liquid toner from the imaging  
25 member to the substrate at a transfer location, and (4) a fusing unit for fusing of the liquid toner into the image on the substrate. The apparatus further comprises a liquid removal unit for removal of carrier liquid from the liquid toner, which liquid removal unit is configured to remove carrier liquid while the liquid toner is present on the substrate and at a liquid removal location arranged downstream of said transfer location and upstream of said fusing unit.

30 According to a second aspect, the invention provides a process of digitally printing an image on a substrate, comprising the steps of

- applying liquid toner comprising toner particles in a carrier liquid on a development member
- charging said liquid toner;
- transferring the liquid toner to an imaging member arranged in contact with said  
35 development member under the impact of an electric field according to a pattern of electric charge forming a latent image on the imaging member;

- transferring the liquid toner from the imaging member to the substrate at a transfer location,
- removing carrier liquid from the liquid toner subsequently to the transfer to the substrate, so as to obtain a densified liquid toner dispersion, and
- fusing the densified liquid toner into the image on the substrate.

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The present invention is based on the insight that ghost fusing images are particularly due to incorrect fusing. It was understood that ghost images may occur when a plurality of layers of liquid toner is present on the substrate, and especially on top of each other. The volume of liquid that is liberated during coalescence is then significant. Artefacts may appear, such as the formation of an insulating layer, which reduces heat transfer during fusing. Therefore, in accordance with the invention, carrier liquid is removed prior to fusing, but after transfer to the substrate, since the system still requires a large enough amount of carrier liquid to guarantee a good electrophoretic transfer from the roller to the substrate prior to the fusing

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In one preferred embodiment, the removal unit are embodied as a removal member that is in use in rotational contact with at least an outer layer of the liquid toner dispersion, as transferred to the substrate. The use of such a removal member has been found to allow liquid removal at a sufficiently high flow rate, so as not to disturb the printing. Such a removal member is particularly a roller. It may be porous or non-porous. Particularly when porous, it may be beneficial to integrate a channel into the roller, through which the carrier liquid may be removed from the roller.

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Alternatively, liquid may be removed from a surface of the roller.

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In one embodiment, the liquid removal unit comprises a sponge member and a pressure member respectively arranged for rotating at either side of the substrate. The sponge member is arranged to face the side of the substrate carrying the portion of liquid toner. Preferably, the sponge member has an outer layer adapted to absorb carrier liquid, such that said sponge member absorbs carrier liquid whilst rotating over the portion of liquid toner.

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In further implementations, the outer layer of the sponge member may be configured for absorbing carrier liquid whilst keeping particles having a size above a critical size at the outer surface. The critical size is typically below 200 nm, and preferably lies in a range between 5 nm and 200 nm, e.g. in a range between 20 nm and 200 nm. In a possible embodiment, the outer layer is adapted for absorbing the carrier liquid by capillary action.

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According to another implementation, the outer layer may comprise a semi-permeable membrane adapted for being semi-permeable vis-à-vis the carrier liquid, while blocking the toner particles. When a semi-permeable membrane is used, the removal means could be e.g. a number of suction channels arranged in the sponge member for removing the carrier liquid that has permeated through the semi-permeable membrane. According to again another implementation, the carrier liquid removal unit may comprise suction means without the provision of a barrier for the toner

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particles. Such embodiments will be possible if the toner particles adhere well to the substrate so that there is substantially no risk that the particles are removed with the carrier liquid.

More preferably, the liquid removal unit is configured for applying an electric field so as to attract charged toner particles in the liquid toner to a surface of the substrate. Thereto, it is deemed

5 beneficial, in one implementation, that the removal member comprises an electrically conductive material to which a voltage may be applied. The electrically conductive material is suitably a metal. It will therefore be understood that the removal member is suitably based on metal, but that it also may contain non-metal parts and/or layers and coatings like a conductive rubber roller.

The applied voltage will be such that the charged elements in the liquid toner are moved towards  
10 the substrate surface and hence away from the rotational member. Thereto, it is suitable that a support member is present at the opposed side of the substrate, which support member is held at another potential, for instance ground.

The applied voltage is particularly chosen such that layer splitting occurs. The splitting will occur  
15 between a first layer rich in toner particles adjacent to the substrate surface and an outer layer primarily consisting of carrier liquid. It will be understood that the first layer and the outer layer may gradually change over, or that an intermediate layer would be formed in between of the outer layer and the first layer.

The applied voltage will depend on the exact composition of the liquid toner, and the amount of  
20 charging applied thereto. Typically, the charge is fixed within the liquid toner dispersion on the dispersing agent and optional other agents. Neither the carrier liquid, nor the binder resin is easily charged. In one suitable embodiment, the liquid toner dispersion further comprises a spacer agent, with the function to space individual toner particles and individual dispersing agents apart.

Agglomeration of toner particles will hide charged groups and therefore decrease the susceptibility  
25 of the particles for the electrical field. Typically the applied voltage at the removal location will be higher than any voltage difference present at the imaging member. Spacer agents suitable for liquid toner dispersions are described in the non-published applications NL2010807 and NL2012115, which are included herein by reference.

In one embodiment, the applied voltage difference in the liquid removal location is higher than a  
30 voltage difference present at the imaging member. Typically, the imaging member may have such voltage to define a latent image in electrical manner, however without any intention or effect of layer splitting.

In order to optimize the process, and suitably reduce the voltage to be applied, the liquid toner  
dispersion may be subjected to a further charging treatment after its transfer to the substrate and  
35 prior to the liquid removal. Thereto, in a preferred embodiment, a charging unit, such as a corona treatment device, is arranged downstream of the transfer location and upstream of the liquid

removal location. If desired, a further discharging treatment could be applied between the liquid removal and the fusing.

The liquid removal at the removal location is preferably combined with a non-contact type of fusing, for which appropriate means will be present, for instance near or far infrared irradiation and/or hot air flow. Such non-contact type fusing has the advantage of minimizing the risk of  
5     distorting the image onto the substrate since the first step of the fusing takes place without the toner image being present in an electric field. It is particularly due to preceding liquid removal of the invention that any non-contact fusing may be carried out in an efficient manner.

More preferably, the fusing unit comprises means for non-contact coalescence (or non-contact  
10     fusing) and downstream thereof means for contact-fusing. The means for contact fusing are for instance embodied as hot rollers.

In a further implementation of this preferable embodiment, a first carrier liquid removal unit is provided upstream of the means for non-contact coalescence and a second carrier liquid removal unit is provided downstream of said means for non-contact coalescence but upstream of the means  
15     for contact-fusing. The order of steps is then a first carrier liquid removal step, a non-contact coalescence step, a second carrier liquid removal step and a contact fusing step. This implementation further reduces the possibility of ghost fusing to occur.

Suitably, a plurality of imaging stages is present, each imaging state comprising a development  
20     member and imaging member and transfer means and being configured for transfer of liquid toner dispersion according to a predefined pattern to the substrate.

According to a first implementation, a first and a second imaging stage and the liquid removal unit are arranged such that liquid is removed from the liquid toner dispersions of the first and the second imaging stages at a first removal location. According to this implementation, the number of  
25     removal unit and removal locations is smaller than the number of imaging stages. In one embodiment, the apparatus comprises merely one liquid removal location. In an alternative embodiment, the number of imaging stages per liquid removal location is typically two or three. It is however not excluded that for specific imaging stages, which require a large amount of carrier liquid a separate imaging stage would be present. The amount of carrier liquid removal stations can  
30     also be dependent upon the nature of the substrate and in case of a very absorbing substrate the carrier liquid removal devices on the substrate can be disabled. According to a second implementation, a first and a second imaging stage and the liquid removal unit are arranged such, that liquid is removed from the liquid toner dispersion of the first imaging stage at a first removal location located downstream of the transfer location of the first imaging stage and upstream of the  
35     transfer location of the second imaging stage, and that liquid is removed from the liquid toner dispersion of the second imaging stage at a second removal location downstream of said transfer

location of the second imaging stage. This second implementation has the advantage that the carrier liquid is removed quickly after the transfer to the substrate. This reduces the risk for damage of the substrate or changes in transparency of the substrate due to the impregnation of the substrate with carrier liquid.

5 Arrangements and implementations for the imaging stages are in itself known to the skilled person. Suitably, the development member is provided with a carrier liquid displacement device, which is placed upstream of an interface with the imaging member, in a position adjacent to the development member, and is configured to create a spatial separation of the toner particles and the carrier liquid within the toner, whereby the carrier liquid is displaced to the surface of the toner layer, to supply or adjust the charge on the individual toner particles. Such a carrier liquid displacement device is deemed suitable to arrange the transfer from the development member to the imaging member. Preferably, such carrier liquid displacement device is embodied as a corona generating device.

10 In one embodiment, an additional transfer member may be present between the imaging member and the substrate, so as to remove carrier liquid. The transfer member of this embodiment is suitably a porous member, suitable for adsorption of liquid into the interior of the transfer member and to keep the toner particles at the surface of the transfer member. This transfer member is further described in the non-prepublished application NL2011067, which is herein included by reference.

20 In another embodiment, use is made of a liquid toner dispersion comprising a decomposable dispersing agent, such as described in the non-prepublished patent application NL2011064 in the name of Applicant, which is herein included by reference. Such a decomposable dispersing agent preferably comprises an anchoring group, a stimulus responsive part and a stabilizing part. By performing the decomposition before the carrier liquid removal takes place, more carrier liquid can be removed resulting in a better coalescence and better fusing performance.

## INTRODUCTION OF THE FIGURES

30 These and other aspects of the invention will be further elucidated with reference to the figures, which are diagrammatical in nature and not drawn to scale and wherein:

Fig. 1 is a schematic view illustrating a first embodiment of the invention;

Fig. 2 is a schematic view illustrating a second embodiment of the invention; and

Fig. 3 illustrates schematically a further embodiment of a transfer member of the invention.

## DETAILED DISCUSSION OF ILLUSTRATED EMBODIMENTS

The Figures are not drawn to scale and purely diagrammatical in nature. Equal reference numerals in different Figures refer to equal or corresponding features.

5           Figure 1 illustrates diagrammatically a first embodiment of a digital printing apparatus of the invention, comprising a reservoir 100, a feed member 120, a toner member 130, an imaging member 140, a intermediate member 150 and a support member 160. A substrate 199 is transported between intermediate member 150 and support member 160. Both the development member 130 and the imaging member 140 and also the intermediate member 150 can function as the first member according to the invention, and are shown to be provided with a removal device 10  
133, 146, 153, and with treatment means 132, 240, 250, 260. Without loss of generality, the aforementioned members are illustrated and described as rollers, but the skilled person understands that they can be implemented differently, e.g. as belts.

          In operation, an amount of liquid toner dispersion, initially stored in a liquid toner dispersion reservoir 100, also called main reservoir, is applied via a feed member 120, to a development member 130, an imaging member 140, and an optional intermediate member 150, and finally to a substrate 199. The development member 130, imaging member 140, and intermediate member 150 all transfer part of the liquid toner dispersion 100 adhering to their surface to their successor; the part of the liquid toner dispersion 100 that remains present on the member's surface,  
20 i.e. the excess liquid toner dispersion, which remains after selective, imagewise transfer, is removed after the transfer stage by appropriate means. The development member 130, the imaging member 140 and the intermediate member 150 may all act as the first member.

          The charging of the toner on the development roll is done by charging device 131. This charging device can be a corona or a biased roll. By charging the toner the liquid toner dispersion  
25 splits into an inner layer at the surface adjacent of the development member 130 and an outer layer. The inner layer is more rich in toner particles and the outer layer is richer in carrier liquid. The transition between these two layers may be gradual.

          Upon transfer of the liquid toner dispersion from the development member 130 to the imaging member 140, excess liquid toner dispersion is left on the development member 130. Ideally, this  
30 excess liquid toner dispersion is present only in "non-image" areas, i.e. areas not corresponding to the image to be printed on the substrate, which is specified by the imaging member. However, it is not excluded that a thin layer remains on the development roller 130 at the area of the transferred image. .

          Figure 1 further shows a discharging corona 132 that is provided downstream of the area  
35 of the rotational contact between the toner roller 130 and the imaging roller 140. The discharging corona 132 is suitable for changing/removing the charge in the dispersion. Further, downstream of

the discharge corona 132 there is provided an additional member 240. In this example, the additional member is embodied as a loosening roller, which is provided with a rubbing portion. This is useful for improvement of mixing of the excess liquid toner dispersion with the added spacer agent. Similar loosening rollers 250, 260, which could be simply addition rollers without a  
5 dedicated rubbing portion, are present in rotational contact with the imaging member 140 and the intermediate member 150 respectively. Thereafter, a removal device is present, which most suitably is a scraper 133. The removed material is preferably recycled into fresh liquid toner.

A sensitive step in the printing process is the fusing of the liquid toner. This fusing is to result in coalescence of the toner particles on the paper. Typically use is made of a heat treatment  
10 that takes place shortly before, during or more preferably shortly after the transfer of the dispersion to the substrate. The term 'coalescence' refers herein to the process wherein toner particles melt and form a film or continuous phase that adheres well to the substrate and that is separated from any carrier liquid. Suitably, the carrier liquid is thereafter removed in a separate step, for instance by means of rollers, by means of blowing off the carrier liquid, by means of suction. Suitably, this  
15 process occurs at "high speed", for instance 50 cm/s or more, so as to enable high-speed printing. During the the fusing it is necessary to avoid formation of an emulsion, since an emulsion does not give a good printing image because film formation is omitted. The presence of the spacer agent(s) does not or not significantly interfere with this filming behaviour at elevated temperature.

According to the invention, use is made of a liquid removal unit 650 that removes liquid  
20 from the substrate 199. The liquid removal unit 650 is suitably embodied as a member that is in rotational contact with the substrate, or at least with an outer layer of the liquid toner dispersion transferred to the substrate. It is deemed suitable to provide a counter-member 690 at the opposed side of the substrate 199. The liquid removal unit 650 is particularly provided upstream of a fusing unit 670. In this manner formation of a ghost fusing image is prevented, which is believed to be  
25 due thereto, that too much carrier liquid is available in the liquid toner dispersion during fusing, especially when a plurality of liquid toner dispersions – transferred from separate imaging stages - are present on top of each other on the substrate 199. The inventors have observed that, in order to avoid ghost fusing patterns, removing the carrier liquid before non-contact fusing is much more adequate than removing the carrier liquid during contact-fusing, i.e. by means of hot rollers.  
30 Moreover, the amount of liquid to be removed may be controlled in dependence of the substrate type.

In a preferred embodiment, use is made of a liquid removal unit 650 comprising means for applying a voltage difference over the liquid toner dispersion. This means are suitably embodied as  
35 an electrical conductor coupled to any voltage source. The counter-member 690 herein constitutes the counter electrode. The voltage is herein applied in such a manner that the charged toner

particles are pushed to the substrate 199, such that carrier liquid and toner particles are split up between a first and a second layer. The second, outer layer of carrier liquid may then be removed with the removal unit 650. The removal unit 650 may thereto be porous, and could further comprise means for absorption or suction. Alternatively, the carrier liquid may be adhered to a surface of the rotational member of the removal unit 650, and therewith be removed. The adhered liquid film will again be removed from the rotational member. This can be done, in one suitable embodiment with a scraper device.

Rather than applying a positive or negative voltage to the removal unit 650, the unit could be coupled to ground, whereas an appropriate voltage is applied to the counter-member 690.

Rather than applying a voltage difference continuously, this could be done under the control of a control device, particularly for situations, in which a large volume of toner is transferred to the substrate 199 and a large volume of carrier liquid is to be removed. Such situations could for instance be the situations wherein the number of colours (applied from different imaging stages) exceeds a predefined number. Furthermore, such situations could involve situations wherein the pattern results in transfer of a high amount of liquid toner to the substrate; this is the case wherein the pattern is 'rather full' instead of being 'predominantly empty'. Photos typically contain a rather full pattern, whereas the printing of letterhead on paper is an example of a rather empty pattern.

In a further implementation, the liquid toner dispersion is subjected to a further charging treatment after its transfer to the substrate 199 and before removal of carrier liquid in the liquid removal unit 650. The charging treatment is for instance applied by means of a charging unit (not shown), and is for instance a corona treatment. Such a treatment ensures that the charged toner particles are pushed or drawn to the substrate 199.

Figure 2 illustrates an embodiment of a digital printing apparatus according to a second aspect of the invention. The apparatus comprises an imaging member 140 adapted to sustain a pattern of electric charge forming a latent image on its surface; a development member 130 arranged to receive a quantity of liquid toner, and to develop said latent image by transferring a portion of said quantity of liquid toner onto said imaging member 140 in accordance with said pattern. The apparatus further comprises an optional intermediate member 150 and a transfer member 160 arranged for transferring a portion of the liquid toner from the imaging member 140 to a substrate 199. Downstream of the intermediate roller 150, there is provided a carrier liquid removal unit arranged for operating on the portion of the liquid toner transferred from the imaging member to a substrate. In the illustrated embodiment the carrier liquid removal unit comprises a sponge member 650 and a pressure member 690, respectively, which are arranged for rotating at either side of the substrate 199. The sponge member 650 is arranged to face the side carrying the portion of liquid toner. The sponge member 650 has an outer layer adapted to absorb carrier liquid,

such that said sponge member 650 absorbs carrier liquid whilst rotating over the portion of liquid toner. The carrier liquid may be removed from the sponge member 650 by a removal roller 680.

In alternative embodiments the sponge member 650 and removal roller 680 may be replaced by a member as described above in connection with figure 3. According to yet another embodiment the carrier liquid may be sucked away from the substrate 199, e.g. using a carrier liquid removal unit with suction means adapted to collect a large part of the carrier liquid. In such 5 embodiments the fused imaging particles should adhere well to the substrate 199 such that it is avoided as much as possible that imaging particles are removed together with the carrier liquid.

The apparatuses shown in Figure 1 and Figure 2 comprise a fusing unit 670. This fusing 10 unit 670 may take any suitable form as described hereinafter. The fusing unit 670 may be arranged downstream of the carrier liquid removal unit formed by rollers 650, 690, and 680, such that the carrier liquid is removed before fusing. The fusing member 660 is configured to fuse imaging particles of a transferred part of the portion of liquid toner, by heating said transferred part on the substrate 199. Alternatively, there may be provided an image fusing unit using non-contact 15 methods such as IR, UV and EB curing or other known methods of image fusing. Optionally also cooling means can be present downstream the TA area.

Figure 3 illustrates schematically a further embodiment of a transfer member of the invention. In this embodiment the transfer roller 450 is provided with an outer layer 451 carrying a semi-permeable membrane 453 configured for allowing carrier liquid to permeate in the outer layer 20 451, whilst not being permeable for marking particles present in the carrier liquid. The outer layer 451 is configured for collecting the carrier liquid, and the carrier liquid may be sucked out of the outer layer 451 through suction channels 452. Instead of using a semi-permeable membrane, the outer layer 451 may be made of a suitable absorption material adapted for absorbing carrier liquid whilst keeping toner particles at the outer surface as discussed for the first and second above.

25 The carrier liquid of this application is particularly a substantially non-polar carrier liquid. The term 'substantially non-polar' refers in the context of the present invention to a chemical entity that is overall non-polar even though it may contain some polarisable groups such as ester, hydroxyl group, and/or carboxyl group. The substantially non-polar carrier liquid is suitably selected from the group consisting of a mineral oil, a low or high viscosity liquid. Specific 30 examples include silicone fluids, mineral oils, low viscosity or high viscosity liquid paraffin, isoparaffinic hydrocarbons, fatty acid triglycerides, fatty acid esters, vegetable oils or any combinations thereof. The carrier liquid may further contain variable amounts of additives, such as charge control agent (CCA), wax and plasticizers. Typical commercially available carrier liquids are Isopar L, Isopar M and Isopar V and higher boiling point Isopars from Exxon, white mineral 35 oils from Sonneborn Inc., Paraffin oils of Petro Canada and vegetable oils from Cargill or oils derived from vegetable sources by chemical means.

In the context of the present invention, the liquid toner is a dispersion of toner particles in a carrier liquid. The toner particles, according to this invention, comprise coloured particles (also called ink particles or pigment) and a binder resin although non pigmented resin systems also can be used containing a phosphor or taggant or UV active material. Typically, the diameter of the toner particles is about 0.5 to 4.0  $\mu\text{m}$ . The toner particles suitably have a concentration of about 40-95 % of binder resin. The binder resin is a polymer, preferably transparent, that embeds the ink particles. Preferably, a polyester resin is used as binder resin. Also other types of resin having a very low or no compatibility with the carrier liquid and dispersing agent can be used. Preferably, the resin has a high transparency, provides good colour developing properties and has a high fixing property on the substrate.

The liquid toner is particularly used in a concentration with an appropriate solid content. The removal of carrier liquid from the substrate may be an additional removal, in addition to carrier liquid removals at the imaging member. Generally, the starting concentration of carrier liquid may herein be reduced, so as to avoid caking issues. Caking is the issue that liquid toner residue remaining for instance on the development member in the patterned transfer step, forms lumps in the dispersion resulting in a liquid with a non-uniform distribution of toner particles. This often results in an increase of the viscosity of the liquid dispersion and partial jelly fractions of ink. This viscosity increase is significant and could be a tenfold increase or even more. The removal of the liquid toner residue starts then to be problematic. As a result, liquid toner residue could remain on the development roller, which constitutes a contamination and may lead to a non-uniform distribution of fresh toner dispersion resulting in an image quality that is not perfect, in other words incorrect. Examples of issues are density instability and incorrect reproduction of fine lines.

A typical solid content of liquid toner dispersion during printing is a solid content of between 10 to 30 wt%, such as a solid content of 25 wt%. The solid content of the concentrated toner before dilution can go up to 50 or 60 % According to this invention, "solid content" means the amount of toner particles in wt% with regard to the total liquid toner dispersion.

The term 'dispersing agent of the hyper-dispersant type' refers to a dispersing agent provided with anchor groups to which stabilising groups are coupled. Suitably examples of anchor groups of the dispersing agent are amine-functionalized polymers, such as polyalkyleneimines, for instance polyethyleneimine (PEI) and polyallylamines. The stabilizing groups of the dispersing agent are suitably chosen from the groups of fatty acid compounds and polyolefins, but similar groups are not excluded. The fatty acid compounds are for instance hydroxylated, and may be polymerized. A suitable degree of polymerization is for instance 2 to 401 (monomer) to 7. The amine functionality of this backbone can be partly or completely converted to amides or quaternized.

Preferred examples of the stabilizing groups and the dispersing agent in its entirety have been described in Applicants' non-prepublished patent applications NL2011955 and NL2012086, which are herein included by reference. Alternatively, use may be made of commercially available dispersing agent, such as Solsperse<sup>TM</sup> 13940, Solsperse<sup>TM</sup> 11000, which again combine a polyamine anchor group with polymeric stabilizing groups.

In a further embodiment, use can be made of a decomposable dispersing agent, such as described in the non-prepublished patent application NL2011064 in the name of Applicant, which is herein included by reference. Such a decomposable dispersing agent preferably comprises an anchoring group, a stimulus responsive part and a stabilizing part. The stimulus responsive part is herein suitably a photolabile group, that is suitably stimulated under irradiation with UV or infrared radiation. A suitable example is a diazene group or a benzoyl group. The latter is deemed suitable so that a rearrangement within the stimulus responsive part occurs. Such rearrangement involves for instance formation of a cyclic structure. Electron-donating groups may be present to simplify or enable formation of such cyclic structure. Moreover, the benzoyl (i.e. Ph-(C=O)-) group may be substituted on the phenyl-side (for instance with the anchoring part) and on the carbonyl-side (for instance with a stabilizing part). More specific examples of suitable photolabile groups are ortho-nitrobenzyl derivatives, a derivative of bis(2-nitrophenyl)methyl formate, a derivative of (E)-di(propan-2-yl)diazene, a benzoin derivative. More specific examples can be found in the above mentioned application NL2011064. The anchoring part is for instance an acrylate- or amine-functionalized polymer, having a plurality of binding sites (i.e. amine or acrylate groups) for binding to a substrate, more particularly the toner particle. Suitably use is made of aliphatic amines, such as linear amines, for instance polyallylamines and poly(alkylene)imines, wherein the alkylene preferably is chosen from C<sub>2</sub>-C<sub>4</sub>-alkylene. One suitable example is a polyethylene-imine. The stabilizing part is a more particularly a hydroxylated fatty acid compound (or polymer), but alternatively or additionally a polyolefine.

The term 'spacer agent' relates to an agent that is different from a dispersing agent and which spacer agent enables that the toner particles are kept at a minimum distance. Use is for instance made of hydrophobic colloidal particles, such as hydrophobic silica particles, aluminium oxide particles, titanium oxide particles or mixtures thereof. Such colloidal particles suitably have a particle size between 5 and 200 nm, more preferably between 30 and 100 nm and are for instance used in a concentration of 0.8-28 wt%, more preferably 2-12 wt% with respect to the weight of the toner particles.

Alternatively, use may be made of spacer agents that primarily comprise stabilizing moieties, such as used in the dispersing agent, however without any anchoring group. The stabilizing moieties of the spacer agent can therefore interact with the stabilizing and anchoring

moieties of the dispersing agent. It is believed by the inventors that this interaction results in creating less attraction between the toner particles by elongation of the existing tails (stabilizing groups) of the dispersing agent ('DA-tails'), by creating inter-tail distortion by other conformational structures or by increasing the number of DA-tails without influencing the charging and/or fusing. This spacer agent typically comprises a polar head group which is essentially a single functional group (single site). Suitable examples of polar head groups are acids, such as carboxylic acid, sulphonic acids, anhydrides, such as succinic anhydride and amides and imide groups. The term 'tail' is used in the context of the present invention as a molecular part that is long on a molecular level and wherein the chemical function is primarily derived from its extension rather than the presence of specific functional groups. The tail of the spacer agent is preferably a polymer comprising a plurality of repetitive units with a weight-average molecular weight of less than 5000 g/mol, preferably in the range of 800-4000 g/mol. Suitably, the tail is based on a monomer compound comprising a carbon chain with at least one side chain. The monomer compound may contain an alkyl or alkylene group and optionally a carboxylic linking group. The carboxylic linking group is suitably an ester group. The alkyl- and alkylene chains are for instance prepared by combining saturated or unsaturated fatty acid, for instance C8-C26 fatty acids. Good results have been obtained with C16-C20 fatty acids, such as poly(hydroxy stearic acid) and poly(hydroxyricinoleic acid). More preferably, such polymers have a weight-average molecular weight in the range of 1200-3600 g/mol. Alternatively, use can be made of olefin, suitably based on a branched repetitive unit, such as isobutylene. The resulting polyolefin suitably has an average molecular weight in the range of 800-251800 g/mol.

## Conclusies

1. Digitaal printapparaat waarin gebruik gemaakt wordt van vloeibare toner die tonerdeeltjes in een dragervloeistof bevat voor het printen van een beeld op een substraat, welk apparaat
- 5 omvat:
- een beelddragend deel dat ingericht is om een elektrisch ladingspatroon dat een latent beeld vormt op het oppervlak ervan vast te houden;
  - een ontwikkeldeel dat ingericht is om een hoeveelheid vloeibare toner op te nemen; en om het latent beeld te ontwikkelen door een gedeelte van de hoeveelheid vloeibare

10 toner over te dragen op het beelddragend deel in overeenstemming met het patroon;

  - middelen voor overdracht van de vloeibare toner dispersie van het beelddragend deel naar het substraat op een overdrachtsplaats;
  - een fusing-eenheid voor het tot een eenheid omvormen (engels: fusing) van de vloeibare tonerdispersie tot het beeld op het substraat,

15 waarin het apparaat voorts een eerste verwijdereenheid voor vloeistof bevat, die geplaatst is om op het gedeelte van de vloeibare toner te werken, dat is overgedragen van het beelddragend deel naar het substraat, welke eerste verwijdereenheid voor vloeistof bedoeld is voor het verwijderen van dragervloeistof van het genoemde gedeelte van de vloeibare toner op het substraat,

20 en waarbij de fusing-eenheid stroomafwaarts van de verwijdereenheid voor vloeistof geplaatst is, welke fusing-eenheid omvat:

    - middelen voor contactloze coalescentie,
    - stroomafwaarts daarvan een tweede verwijdereenheid voor dragervloeistof, en
    - stroomafwaarts daarvan middelen voor contact-fusing.

25

2. Digitaal printapparaat volgens conclusie 1, waarin de verwijdereenheid voor dragervloeistof een sponsdeel en een drukdeel omvat, welke respectievelijk aangebracht zijn om te roteren aan beide zijden van het substraat.

30

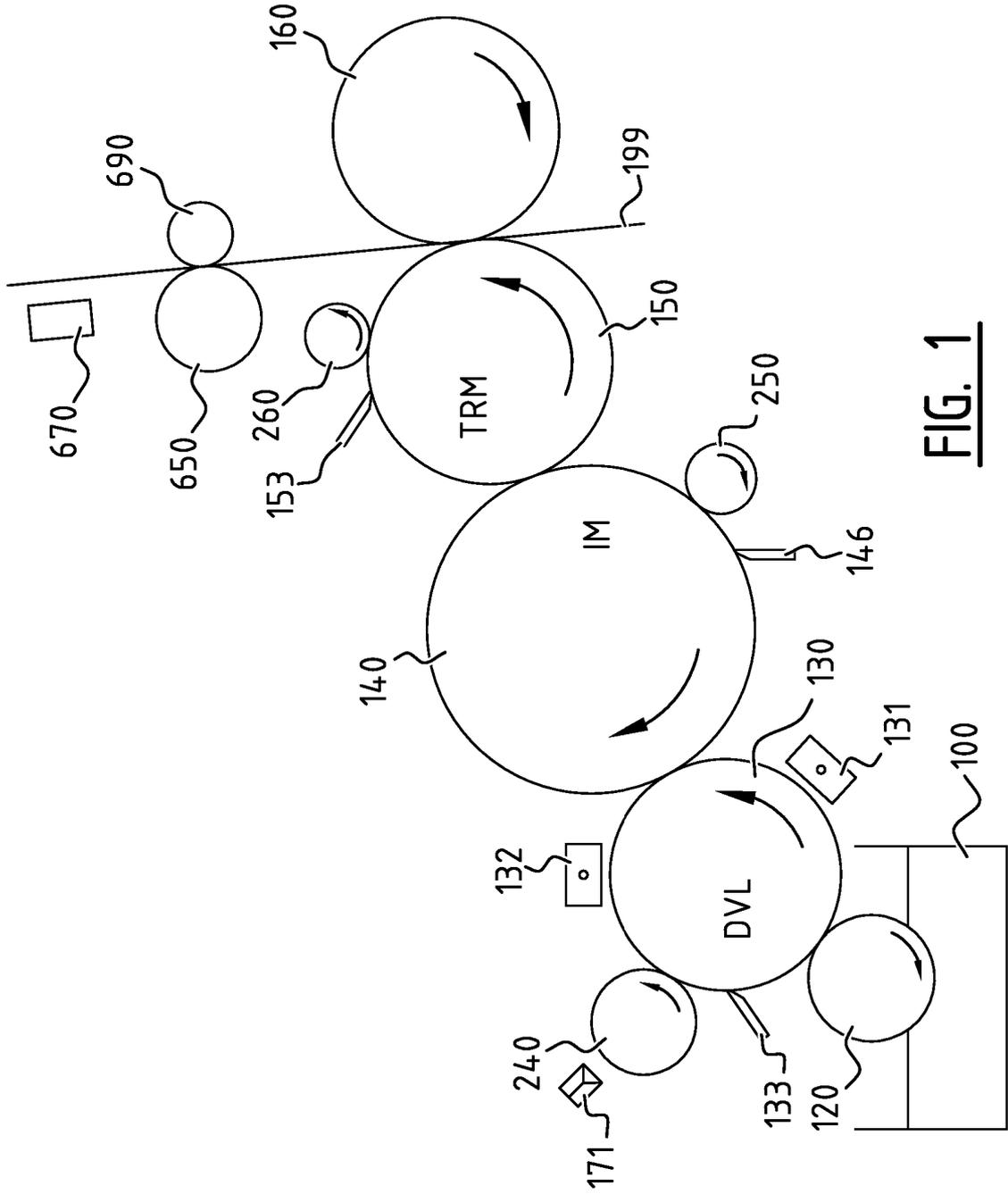
3. Digitaal printapparaat volgens één van de voorgaande conclusies, waarin de verwijdereenheid voor vloeistof belichaamd is als een verwijderdeel dat in bedrijf in draaiend contact is met tenminste een buitenlaag van de vloeibare toner.

35

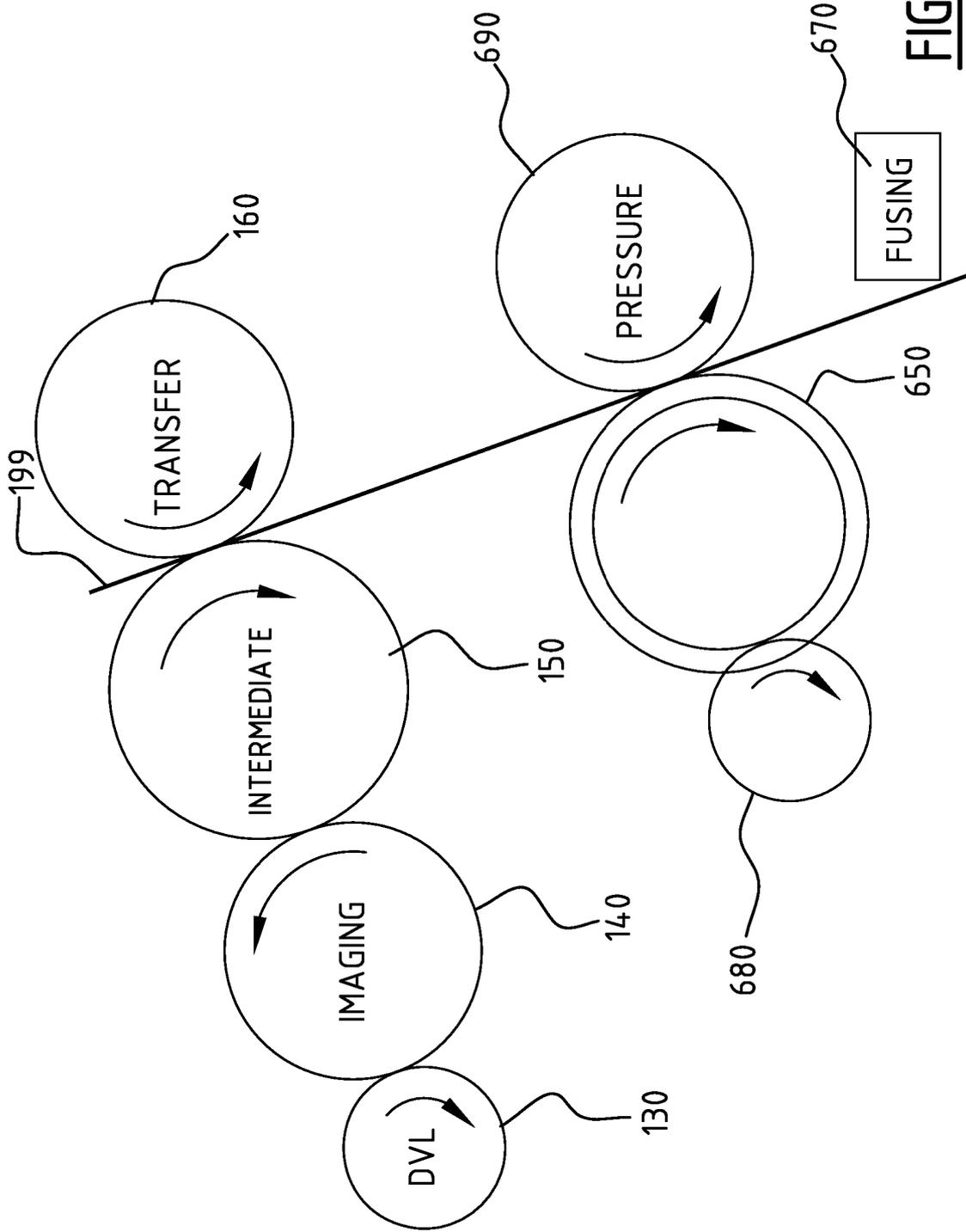
4. Digitaal printapparaat volgens conclusie 1 of 3, waarin de verwijdereenheid voor vloeistof ingericht is voor het aanbrengen van een elektrisch veld teneinde geladen tonerdeeltjes in de vloeibare dispersie aan te trekken tot een oppervlak van het substraat.

5. Digitaal printapparaat volgens conclusie 4, waarin het aanbrengen van het elektrisch veld gecontroleerd wordt om laagsplitsing van de vloeibare tonerdispersie te bewerkstelligen, waarbij de laagsplitsing leidt tot een eerste laag die rijk aan tonerdeeltjes is en zich aan het substraatoppervlak bevindt, en tot een buitenlaag die in hoofdzaak uit dragervloeistof bestaat.  
5
6. Digitaal printapparaat volgens één van de conclusies 3-5, waarin het verwijderingsdeel een elektrische geleider bevat, waarop een spanning aangebracht kan worden, waarbij de spanning zodanig gecontroleerd wordt dat de geladen tonerdeeltjes wordt afgestoten in de richting van het substraatoppervlak.  
10
7. Digitaal printapparaat volgens één van de voorgaande conclusies, waarin een veelheid aan beelddragende deelenheden aanwezig is, waarbij elke beelddragende deelenheid een ontwikkeldeel, een beelddragend deel en overdrachtsmiddelen bevat en ingericht is voor overdracht van vloeibare toner naar het substraat volgens een voorafbepaald patroon.  
15
8. Digitaal printapparaat volgens conclusie 7, waarin een eerste en een tweede beelddragende deelenheid en de verwijdereenheid voor vloeistof zo ten opzichte van elkaar geplaatst zijn, dat vloeistof verwijderd wordt uit de vloeibare toner van de eerste en de tweede beelddragende eenheden op een eerste verwijderplaats.  
20
9. Digitaal printapparaat volgens conclusie 7, waarin een eerste en een tweede beelddragende deelenheid en de verwijdereenheid voor vloeistof zo ten opzichte van elkaar geplaatst zijn, dat vloeistof verwijderd wordt uit de vloeibare toner van de eerste beelddragende deelenheid op een eerste verwijderplaats die stroomafwaarts gelegen is van de overdrachtsplaats van de eerste beelddragende deelenheid en stroomopwaarts van de overdrachtsplaats van de tweede beelddragende deelenheid, en dat vloeistof verwijderd wordt van de vloeibare toner van de tweede beelddragende deelenheid op een tweede verwijderplaats die stroomafwaarts gelegen is van de genoemde overdrachtsplaats van de tweede beelddragende deelenheid.  
25  
30
10. Digitaal printproces gebruikmakend van vloeibare toner, welke vloeibare toner tonerdeeltjes en een dragervloeistof omvat, welk proces omvat:  
35
  - het produceren van een latent beeld als een elektrisch ladingspatroon op een beelddragend deel;

- het overbrengen van een hoeveelheid vloeibare toner op een ontwikkeld deel;
  - het ontwikkelen van het latent beeld door het overbrengen van een gedeelte van de hoeveelheid vloeibare toner op het beelddragend deel in overeenstemming met het patroon;
- 5
- het overbrengen van een ontwikkeld gedeelte van de vloeibare toner op een substraat;
  - het tot een beeld omvormen (fusing) van het ontwikkelde gedeelte van de vloeibare toner met het kenmerk dat:
    - het proces verder het verwijderen van dragervloeistof van het overgebracht ontwikkeld gedeelte omvat, waarbij het omvormen tot een beeld (fusing) uitgevoerd wordt na het
- 10
- verwijderen van de dragervloeistof;
  - het omvormen (fusing) achtereenvolgens de stappen omvat van contactloze coalescentie, een tweede verwijdering van de dragervloeistof en een contact-fusing stap.
- 15
11. Digitaal printproces volgens conclusie 10, waarin het verwijderen van de dragervloeistof de stappen omvat van het splitsen van de vloeibare toner in een eerste laag aan een oppervlak van het substraat en in een tweede buitenlaag, en van het verwijderen van de dragervloeistof uit de tweede buitenlaag, bijvoorbeeld door het aanbrengen van een spanningsverschil over de vloeibare toner.
- 20
12. Digitaal printproces volgens conclusie 10 of 11, waarin de tonerdeeltjes pigment bevatten dat gemengd is met een binderhars en een dispergator van het hyper-dispergator type, dat een ankerende groep bevat voor binding aan een tonerdeeltjes en stabiliserende groepen gekoppeld aan de ankerende groep voor het stabiliseren van het tonerdeeltje in de
- 25
- dragervloeistof.
13. Digitaal printproces volgens conclusie 10, waarin de dragervloeistof verwijderd wordt door middel van capillaire werking of door deze weg te zuigen.



**FIG. 1**



**FIG. 2**

3/3

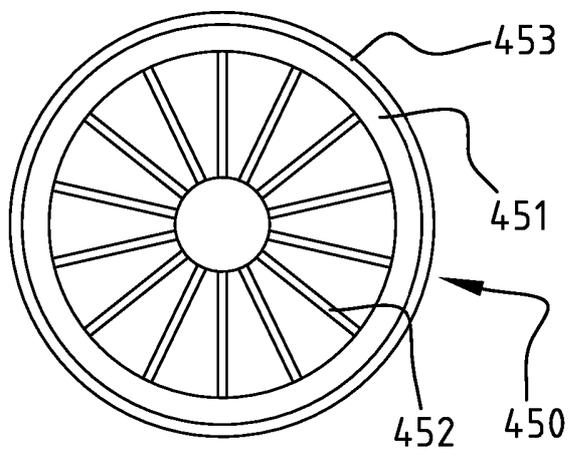


FIG. 3

# SAMENWERKINGSVERDRAG (PCT)

## RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
	<b>2H/2PU19/KM/29</b>
Nederlands aanvraag nr.	Indieningsdatum
<b>2012525</b>	<b>28-03-2014</b>
	Ingeroepen voorrangsdatum
	<b>28-06-2013</b>
Aanvrager (Naam)	
<b>Xeikon IP B.V.</b>	
Datum van het verzoek voor een onderzoek van internationaal type	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr.
<b>10-06-2014</b>	<b>SN 62129</b>
<b>I. CLASSIFICATIE VAN HET ONDERWERP</b> (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)	
Volgens de internationale classificatie (IPC)	
<b>G03G15/11</b>	<b>G03G5/00</b>
<b>II. ONDERZOCHE GEBIEDEN VAN DE TECHNIEK</b>	
Onderzochte minimumdocumentatie	
Classificatiesysteem	Classificatiesymbolen
<b>IPC</b>	<b>G03G</b>
Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen	
III. <input type="checkbox"/>	<b>GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES</b> (opmerkingen op aanvullingsblad)
IV. <input type="checkbox"/>	<b>GEBREK AAN EENHEID VAN UITVINDING</b> (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 2012525

A. CLASSIFICATIE VAN HET ONDERWERP  
INV. G03G15/11 G03G15/00  
ADD.

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

**B. ONDERZOCHETE GEBIEDEN VAN DE TECHNIEK**

Onderzochte minimum documentatie (classificatie gevolgd door classificatiesymbolen)  
G03G

Onderzochte andere documentatie dan de minimum 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, WPI Data

**C. VAN BELANG GEACHTE DOCUMENTEN**

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	US 6 347 212 B1 (KOSUGI HIDEKI [JP] ET AL) 12 februari 2002 (2002-02-12) * kolom 4, regel 25 - kolom 7, regel 23; figuur 1 *	1-15
X	JP 2009 163065 A (MITSUBISHI HEAVY IND LTD) 23 juli 2009 (2009-07-23) * samenvatting; figuren 1-3 *	1-15
X	US 4 985 733 A (KUROTORI TSUNEO [JP] ET AL) 15 januari 1991 (1991-01-15) * kolom 4, regel 56 - kolom 10, regel 49; figuren 3, 7, 8 *	1-15
X	US 6 148 169 A (TSUKAMOTO TAKEO [JP]) 14 november 2000 (2000-11-14) * kolom 7, regel 24 - kolom 21, regel 51; figuren 5-14 *	1-15
	----- -/--	

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 octrooiaanvraag vermeld

\*E\* eerdere octroof(aanvraag), 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 voorrangdatum en de indieningsdatum gepubliceerde literatuur

\*T\* na de indieningsdatum of de voorrangdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvraag, 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

\*Z\* lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid

25 juni 2014

Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type

Naam en adres van de instantie

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040,  
Fax: (+31-70) 340-3016

De bevoegde ambtenaar

Billmann, Frank

**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 2012525

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN		
Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	JP 2009 282280 A (KONICA MINOLTA BUSINESS TECH) 3 december 2009 (2009-12-03) * samenvatting; figuren 1-6 *	1-15
A	US 5 723 251 A (MOSER RASIN [US]) 3 maart 1998 (1998-03-03) * het gehele document *	1-15

**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 2012525

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 6347212	B1	JP 2001337572 A US 6347212 B1	07-12-2001 12-02-2002
-----			
JP 2009163065	A	23-07-2009	GEEN
-----			
US 4985733	A	DE 3910481 A1 US 4985733 A	15-01-1991 19-10-1989 15-01-1991
-----			
US 6148169	A	14-11-2000	GEEN
-----			
JP 2009282280	A	03-12-2009	GEEN
-----			
US 5723251	A	03-03-1998	GEEN
-----			

## WRITTEN OPINION

File No. SN62129	Filing date (day/month/year) 28.03.2014	Priority date (day/month/year) 28.06.2013	Application No. NL2012525
International Patent Classification (IPC) INV. G03G15/11 G03G15/00			
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 Billmann, Frank
--	-----------------------------

## WRITTEN OPINION

Application number  
NL2012525

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### Box No. I Basis of this opinion

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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

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#### 1. Statement

Novelty	Yes: Claims	11, 14
	No: Claims	1-10, 12, 13, 15
Inventive step	Yes: Claims	
	No: Claims	1-15
Industrial applicability	Yes: Claims	1-15
	No: Claims	

#### 2. Citations and explanations

**see separate sheet**

**WRITTEN OPINION**

Application number  
NL2012525

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**Box No. VII Certain defects in the application**

see separate sheet

---

**Box No. VIII Certain observations on the application**

see separate sheet

**Re Item V**

**Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

Reference is made to the following documents:

Reference is made to the following documents:

- D1 US 6 347 212 B1 (KOSUGI HIDEKI [JP] ET AL) 12 februari 2002 (2002-02-12)
- D2 JP 2009 163065 A (MITSUBISHI HEAVY IND LTD) 23 juli 2009 (2009-07-23)
- D3 US 4 985 733 A (KUROTORI TSUNEO [JP] ET AL) 15 januari 1991 (1991-01-15)
- D4 US 6 148 169 A (TSUKAMOTO TAKEO [JP]) 14 november 2000 (2000-11-14)
- D5 JP 2009 282280 A (KONICA MINOLTA BUSINESS TECH) 3 december 2009 (2009-12-03)
- D6 US 5 723 251 A (MOSER RASIN [US]) 3 maart 1998 (1998-03-03)

**1 Lack of novelty/ inventive step**

The present application does not meet the criteria of patentability, because the subject-matter of all claims is not new and/or does not involve an inventive step.

**1.1 Independent claim 1**

1.1.1 **D1** discloses [see fig. 1; col. 4, l. 25 to col. 7, l. 23] all features of claim 1, in particular, see the digitaal printapparaat of fig. 1 comprising beelddragend deel 10, ontwikkeldeel 40, middelen voor overdracht 11-14, 60, fusing-eenheid 90 and vervrijdereenheid 150 (col. 5, l. 53-55).

Hence, claim 1 is not new over **D1**.

1.1.2 Claim 1 is also not new over **D2** [see the abstract, fig. 1-3], over **D3** [see fig. 3, 7, 8; col. 4, l. 56 to col. 10, l. 49], over **D4** [see fig. 5-14, col. 7, l. 24 to col. 12, l. 51 and note that, e.g., fixing unit 14d of fig. 14 is also downstream of removal unit 14a], and over **D5** [see the abstract, fig. 1-6].

1.2 Independent claim 12

For similar reasons as indicated above relating to claim 1, also claim 12 is not new over each of D1-D5.

1.3 Dependent claims 2-11, 13-14

Dependent claims 2-11, 13-15 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step.

E.g., claims 2, 3, 9, 10, 13, 15 are not new over D1 (see the prior art passages cited above), claims 7, 8, 13 are not new over D2 (see the prior art passages cited above), claims 2-6, 13, 15 are not new over D3 (see the prior art passages cited above), claims 3-6, 13 are not new over D4 (see the prior art passages cited above), claims 3, 13 are not new over D5 (see the prior art passages cited above) and claims 11, 14 merely disclose obvious modifications having no surprising effect.

**Re Item VII**

**Certain defects in the application**

- 1 Independent claims 1, 12 are not in the two-part form, which in the present case would be appropriate, with those features known in combination from the prior art being placed in the preamble and the remaining features being included in the characterising part.
- 2 The features of all claims are not provided with reference signs placed in parentheses.
- 3 The relevant background art disclosed in D1-D6 is not mentioned in the description, nor is this document identified therein.

**Re Item VIII**

**Certain observations on the application**

The statement in the description on p. 2, l. 16 to p. 3, l. 4 implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity when used to interpret them.