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(54) A METHOD FOR PREVENTING BLEEDING AT THE BORDER OF AN IMAGE ELEMENT

(57) The present invention relates to a method for printing an image using an ink to prevent bleeding of border region of an image element by applying an accelerator composition at the border region and applying a treatment step to the image element to fixate the border region of said image element.

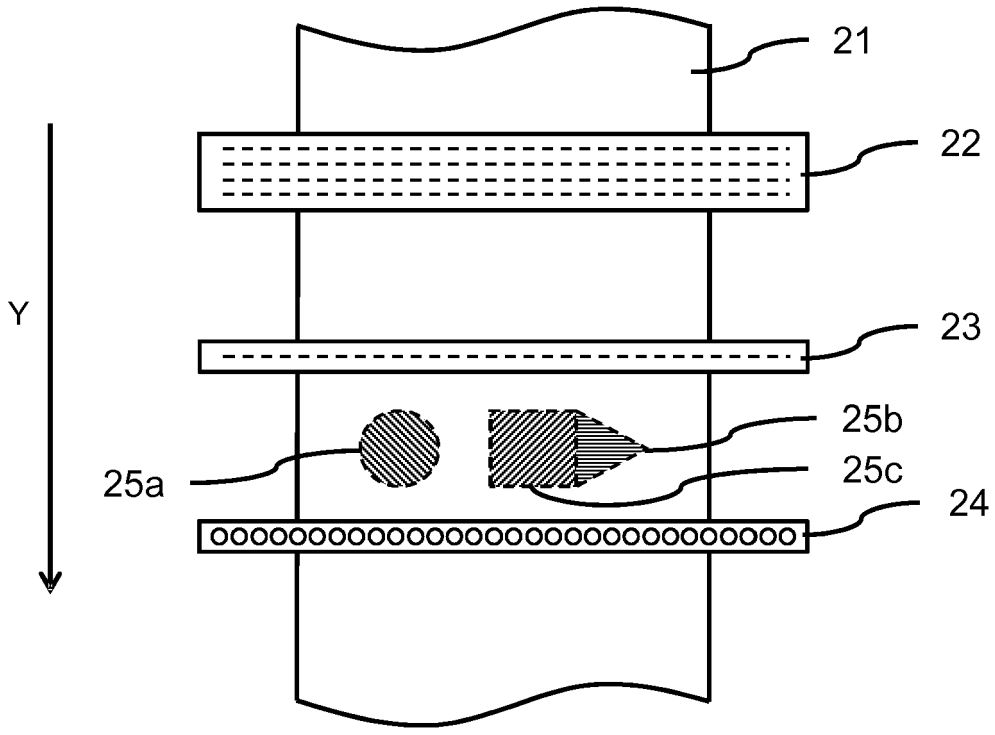

FIG. 2B

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method for printing an image wherein the border region of an image element is fixated.

BACKGROUND ART

[0002] In a copier, a printer or any other machine an image may be created by one or more image elements which are formed by jetting ink droplets of a particular color onto a print medium in a specific droplet pattern. Thus when an image is created using an ink, the created image may contain one or more image elements such as an individual text character or a single colored shape like the part of a logo. When printing an image using an inkjet printer, ink jetted on a print medium may tend to spread and flow into the medium or into neighboring ink droplets. Images containing more than one image element wherein the image elements are adjacent to each other, such as a multicolor logo, may thus show a so-called bleeding effect at the border region of such an image element resulting in a vague or blurry image and/or image element.

[0003] When printing an image using a UV-curable ink, this bleeding effect at the border region of an image element can be prevented by selectively radiating and curing the UV ink at the border region. This can be seen for instance in patent US 7,607,773. This method, however, requires a UV radiation source and control unit capable of radiating individual ink droplets or a small group of ink droplets that constitute a pixel. Radiation of an individual ink droplet or a small group of ink droplets will thus be difficult and expensive.

[0004] It is therefore an object of the present invention to overcome the disadvantage of the prior art by providing a method of for printing an image wherein the border region of an image element is fixated in a simple and cheap manner.

SUMMARY OF THE INVENTION

[0005] The object of the invention is achieved in a method for printing an image using an ink, wherein the method comprises the steps of jetting ink droplets onto a medium creating an image element, selectively jetting an accelerator composition at a border region of the image element, applying a treatment step to the created image element thereby activating the accelerator composition to fixate the border region of said image element. The ink droplets may be jetted using an ejection unit configured to, in operation, eject droplets of an ink composition to form an image or an image element. The accelerator composition may be jetted using an ejection unit similar to the ejection unit jetting ink droplets. The accelerator composition may be jetted selectively in regions where bleeding of the ink is most conspicuous such as at the border region of an image element. Thus the accelerator composition may be jetted at the border region of the image element while the remainder of the image element essentially remains uncovered by the accelerator composition. The ejection unit for jetting the accelerator composition and the ejection unit for jetting the ink droplets may be a print head unit. The print head unit may be a piezoelectric actuated print head or a thermally actuated print head. The treatment step may be performed by a treatment unit. The treatment unit may apply a treatment such as UV radiation or heat onto the entire image thereby activating the accelerator composition which is selectively jetted at the regions where bleeding of the ink is most conspicuous. The treatment unit may be a source of electromagnetic radiation suitable for activating the accelerator. Said source may be, for instance, a UV radiation source such as a UV lamp. Alternatively, when the accelerator composition may be activated by for instance heat, the treatment unit may be a heating source such as a heater. The accelerator composition may react only with the ink droplets upon activation by means of the treatment unit and thus the accelerator composition and the ink droplets may have time to mix with each other before interaction between both occurs. By treating the created image element with a low dosage of UV radiation or heat, the treatment step may be sufficient to activate the accelerator composition without curing the rest of the image element that essentially remains uncovered by the accelerator composition. Thereby the accelerator composition jetted regionally may be activated to fixate only the border region of an image element while applying the treatment step to the whole image. The border region of the image element may be the outer edge of the image element where the outer edge of said image element meets the outer edge of another image element and/or where the outer edge of the image element meets a region of the medium uncovered by either ink droplets and/or the accelerator composition. Thus the border region may be the outer edge of an image element where bleeding of ink droplets either into another image element and/or towards an empty region of the medium may occur.

[0006] In an embodiment, the accelerator composition is jetted after jetting ink droplets. In this embodiment, first ink droplets may be jetted onto a medium creating an image element and after the image element is created the accelerator composition may be jetted at a border region of the created image element. It is an advantage of the present embodiment that all the ink droplets are on the same plane and thus all ink droplets may interact with the medium onto which they are jetted.

[0007] In an embodiment, the accelerator composition is jetted before jetting ink droplets. In this embodiment, first the accelerator composition is jetted at a border region of an image element to be created and after the accelerator composition is jetted the ink droplets are jetted to create an image element. It is an advantage of the

present embodiment that the accelerator composition is positioned under the visible image element rather than on top of the visible image element.

[0008] In an embodiment, the ink used to print an image is a UV-curable ink. In this embodiment, the ink droplets jetted onto a medium creating an image element can be cured by the application of UV radiation after the entire image is printed. It is an advantage of the present embodiment that the printed image may be fixated before the image may be dried and thus prevent bleeding of the image before the image is dried.

[0009] In an embodiment, the treatment step to activate the accelerator composition comprises the application of UV radiation onto the image element. In this embodiment, the accelerator composition may be activated by means of UV radiation doses sufficient to activate the accelerator composition. This UV radiation doses may also partially cure the ink droplets. When the accelerator composition jetted is in contact with the ink droplets jetted in the same position, the accelerator composition and the ink droplet may interact with each other and the UV radiation doses sufficient to activate the accelerator composition due to the interaction with the ink droplets may be capable of curing the ink droplets interacting with the accelerator composition. It is an advantage of the present embodiment that only the ink droplets in contact with the accelerator composition are affected by the treatment step.

[0010] In an embodiment, the accelerator composition comprises a thiol. In this embodiment, the thiol acts as a polymerization accelerator when the accelerator composition is in contact with an ink droplet and activated by means of UV radiation. Such a thiol may be multifunctional mercapto compounds such as, for example, pentaerythritol tetra (3-mercaptopropionate), ethoxylated trimethylolpropane Tri (3-mercaptopropionate), or pentaerythritol tetramercapto-acetate.

[0011] In an embodiment, the accelerator composition comprises a transition metal such as Co^{2+}, Fe^{3+}, or Mn^{2+}. In this embodiment, the transition metal acts as a polymerization accelerator when the accelerator composition is in contact with an ink droplet and activated by means of UV radiation. Such a transition metal may be a metal ion complex such as, for example, cobalt(II)2-ethylhexanoate or copper(II)acetate.

[0012] In an aspect of the invention, a printer comprises an ejection unit configured to in operation eject droplets of an ink composition, an ejection unit configured to in operation eject droplets of an accelerator composition, a treatment unit for applying a treatment step to a created image element thereby activating the accelerator composition to fixate the border region of an image element, and a control unit configured to perform the method for printing an image using an ink, wherein the method comprises the steps of jetting ink droplets onto a medium creating an image element, jetting an accelerator composition at a border region of the image element, applying a treatment step to the created image element thereby activating the accelerator composition to fixate the border region of said image element. The printer may thus be configured to perform a method according to the present invention

[0013] In an embodiment the treatment unit for applying a treatment step comprises a UV radiation source. In this embodiment, the UV radiation source is an UV lamp positioned close to the ejection unit to apply radiation almost immediately after jetting of the ink droplets and jetting of the accelerator composition. It is an advantage of the present embodiment that the UV radiation source is capable of activating the accelerator composition without fully curing the entire image element right after both the accelerator composition and ink droplets are jetted.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1A	is a schematic perspective view of a printing system according to the present invention;
Fig. 1B	is a schematic perspective view of an inkjet printing assembly the printing system in Fig. 1A;
Figs. 2A-2C	show a schematic representation of a method according to a first embodiment of the invention
Figs. 3A-3C	show a schematic representation of a method according to a second embodiment of the invention

DETAILED DESCRIPTION

[0015] Fig. 1A shows an image forming apparatus 1, wherein printing is achieved using a wide format inkjet printer. The wide-format image forming apparatus 1 comprises a housing 2 holding the printing assembly 10. The image forming apparatus 1 also comprises at least one media input unit 3 for storing one or more media 8, 9 in the form of a wound-up roll of web medium. The media 8, 9 are supplied by a roll 8, 9. The roll 8 is supported on the roll support R1, while the roll 9 is supported on the roll support R2. A transport path extends from the media input unit 3 along the printing assembly 10 to a receiving unit 4 to collect the medium 8, 9 after printing. A storage unit 19 for marking material is provided to hold marking materials. Each marking material for use in the printing assembly 10 is stored in one of a plurality of containers 19 arranged in fluid connection with the respective print heads for supplying marking material to said print heads to print an image on the medium 8, 9. The receiving unit 4 may comprise a take-up roller for winding up the printed medium 8, 9 or a receiving tray for supporting sheets of printed medium 8, 9. Optionally, the receiving unit 4 may comprise processing means for processing the medium 8, 9 after printing, e.g. a post-treatment device such as a coater, a folder or a puncher. The wide-format image

forming apparatus 1 furthermore comprises a user interface 5 for receiving print jobs and optionally for manipulating print jobs. The local user interface unit 5 is integrated to the print engine and may comprise a display unit and a control panel. Alternatively, the control panel may be integrated in the display unit, for example in the form of a touch-screen control panel. The local user interface unit 5 is connected to a control unit 6 connected to the image forming apparatus 1. The control unit 6, for example a computer, comprises a processor adapted to issue commands to the image forming apparatus 1, for example for controlling the print process. The image forming apparatus 1 may optionally be connected to a network N. The connection to the network N is diagrammatically shown in the form of a cable 7, but nevertheless, the connection could be wireless. The image forming apparatus 1 may receive printing jobs via the network N. Further, optionally, the control unit 6 of the image forming apparatus 1 may be provided with a USB port, so printing jobs may be sent to the image forming apparatus 1 via this USB port.

[0016] Fig. 1B shows an ink jet printing assembly 10. The ink jet printing assembly 10 comprises a medium support surface to support the medium 21 during printing. The medium support surface in Fig. 1B is provided on a platen 11 in the form of a drum rotatable in direction A, but may, alternatively, be a flat support surface. The medium support surface is preferably provided with suction holes for at least temporarily holding the medium 21 in a fixed position with respect to the medium support surface. The ink jet printing assembly 10 comprises print heads 12a - 12d, mounted on a scanning print carriage 13, or alternatively as a stationary page-wide array. The scanning print carriage 13 is guided by suitable guides 14, 15 to move in reciprocation in the main scanning direction B. Each print head 12a - 12d comprises an orifice surface 16, which orifice surface 16 is provided with at least one orifice 17. The print heads 12a - 12d are configured to eject droplets of marking material onto the medium 21. The medium support surface, the carriage 13 and the print heads 12a - 12d are controlled by suitable controlling means 6a, 6b and 6c, respectively.

[0017] The medium 21 is supplied in web form and may be composed of e.g. paper, cardboard, label stock, coated paper, plastic or textile. The medium 21 is moved in the sub-scanning direction A by the platen 11 along four print heads 12a - 12d provided with a fluid marking material.

[0018] A scanning print carriage 13 carries the four print heads 12a - 12d and may be moved in reciprocation in the main scanning direction B parallel to the medium support surface, such as to enable scanning of the medium 21 in the main scanning direction B. Any number of print heads may be employed. Preferably, at least one print head 12a - 12d per color of marking material is placed on the scanning print carriage 13, for example one for print head 12a - 12d for each of the applied colors, usually black, cyan, magenta and yellow is present. Often, in a full-color printer, black marking material is used more frequently in comparison to differently colored marking material. Therefore, more print heads 12a - 12d containing black marking material may be provided on the scanning print carriage 13 compared to print heads 12a - 12d containing marking material in any of the other colors. Alternatively, the print head 12a - 12d containing black marking material may be larger than any of the print heads 12a - 12d, containing a differently colored marking material.

[0019] The carriage 13 is guided by guides 14, 15 in the form of guide rails or rods 14, 15, as depicted in Fig. 1B. The carriage 13 may be driven along the guides 14, 15 by a suitable driving actuator (not shown). An alternative is to move the medium 21 in the main scanning direction B.

[0020] Each print head 12a - 12d comprises an orifice surface 16 having at least one orifice 17, in fluid communication with a pressure chamber containing fluid marking material provided in the print head 12a - 12d. On the orifice surface 16, a number of orifices 17 is arranged in a single linear array parallel to the sub-scanning direction A. Eight orifices 17 per print head 12a - 12d are depicted in Fig. 1B, however obviously in a practical embodiment at least several hundreds of orifices 17 may be provided per print head 12a - 12d, optionally arranged in multiple arrays. As depicted in Fig. 1B, the respective print heads 12a - 12d are placed parallel to each other such that corresponding orifices 17 of the respective print heads 12a - 12d are positioned in-line in the main scanning direction B. This means that a line of image dots in the main scanning direction B may be formed by selectively activating up to four orifices 17, each of them being part of a different print head 12a - 12d. This parallel positioning of the print heads 12a - 12d with corresponding in-line placement of the orifices 17 is advantageous to increase productivity and/or improve print quality. Alternatively multiple print heads 12a - 12d may be placed on the print carriage adjacent to each other such that the orifices 17 of the respective print heads 12a - 12d are positioned in a staggered configuration instead of in-line. For instance, this may be done to increase the print resolution or to enlarge the effective print area, which may be addressed in a single scan in the main scanning direction. The image dots are formed by ejecting droplets of marking material from the orifices 17.

[0021] Upon ejection of the marking material, some marking material may be spilled and stay on the orifice surface 16 of the print head 12a - 12d. The ink present on the orifice surface 16, may negatively influence the ejection of droplets and the placement of these droplets on the medium 21. Therefore, it may be advantageous to remove excess of ink from the orifice surface 16. The excess of ink may be removed for example by wiping with a wiper and/or by application of a suitable anti-wetting property of the surface, e.g. provided by a coating.

[0022] Figs. 2A to 2C show a schematic representation of a method for printing an image according to a first

embodiment of the invention comprising the steps of firstly jetting ink droplets onto a medium creating an image element, then jetting an accelerator composition at a border region of the image element, followed by applying a treatment step to the created image element thereby activating the accelerator composition to fixate the border region of said image element.

[0023] Fig. 2A shows a medium 21, an ejection unit 22 configured to, in operation, ejecting droplet of an ink composition, an ejection unit 23 configured to, in operation, ejecting an accelerator composition, and a treatment unit 24. An ejection unit 22, 23 may be a print head such as a print head 12a-12d shown in Fig. 1B. A treatment unit 24 may be a source of electromagnetic radiation such as a UV lamp. In Fig. 2A, the ejection unit 22 has formed image elements 25a, 25b, and 25c. After the image elements 25a, 25b, and 25c have been formed, the medium will be transported in a direction Y to apply an accelerator composition at the border region of the created image elements as shown in Fig. 2B.

[0024] Fig. 2B shows the medium 21 which has been transported in a direction Y with respect to the situation as shown in Fig. 2A. The ejection unit 23 has jetted an accelerator composition at a border region of the image elements 25a, 25b, and 25c as shown by the dashed line at the border region of image elements 25a, 25b, and 25c. After the accelerator composition has been jetted at the border region of said image elements, the medium will be transported in a direction Y to apply a treatment step to activate the accelerator composition as shown in Fig. 2C.

[0025] Fig. 2C shows the medium 21 which has been transported in a direction Y with respect to the situation as shown in Fig. 2B. The treatment unit 24 has applied electromagnetic radiation such as UV radiation onto the image elements 25a, 25b, and 25c thereby activating the accelerator composition present at the border regions of said image elements. Thus the border regions are fixated as shown by the solid line at the border region of image elements 25a, 25b, and 25c.

[0026] Figs. 3A to 3C show a schematic representation of a method for printing an image according to a second embodiment of the invention comprising the steps of firstly jetting an accelerator composition at a border region of the image element, then jetting ink droplets onto a medium creating an image element, followed by applying a treatment step to the created image element thereby activating the accelerator composition to fixate the border region of said image element.

[0027] Fig. 3A shows a medium 21, an ejection unit 23 configured to, in operation, ejecting an accelerator composition, an ejection unit 22 configured to, in operation, ejecting droplet of an ink composition, and a treatment unit 24. An ejection unit 22, 23 may be a print head such as a print head 12a-12d shown in Fig. 1B. A treatment unit 24 may be a source of electromagnetic radiation such as a UV lamp. In Fig. 3A, the ejection unit 23 has jetted an accelerator composition to from a border region, as shown by the dashed line, for the image elements 25a, 25b, and 25c to be formed later. After the accelerator composition has been jetted at the border region of said image elements, the medium will be transported in a direction Y to form the image elements 25a, 25b, and 25c as shown in Fig. 3B.

[0028] Fig. 3B shows the medium 21 which has been transported in a direction Y with respect to the situation as shown in Fig. 2A. The ejection unit 22 has formed image elements 25a, 25b, and 25c within the border regions formed by the ejection unit 23. After the image elements 25a, 25b, and 25c have been formed, the medium will be transported in a direction Y to apply a treatment step to activate the accelerator composition as shown in Fig. 3C.

[0029] Fig. 3C shows the medium 21 which has been transported in a direction Y with respect to the situation as shown in Fig. 3B. The treatment unit 24 has applied electromagnetic radiation such as UV radiation onto the image elements 25a, 25b, and 25c thereby activating the accelerator composition present at the border regions of said image elements. Thus the border regions are fixated as shown by the solid line at the border region of image elements 25a, 25b, and 25c.

[0030] Alternatively, the treatment unit 24 shown in Figs. 3A, 3B, and 3C may be positioned between the ejection unit 23 and ejection unit 22, or an additional treatment unit may be positioned between the ejection unit 23 and ejection unit 22, to apply electromagnetic radiation such as UV radiation onto the formed border regions of image elements 25a, 25b, and 25c thereby activated the accelerator composition jetted by ejection unit 23 before images elements 25a, 25b and 25c are formed by ejection unit 22.

[0031] According to an aspect of the invention, a printer may be configured to perform a method for printing according to the present invention. Such a printer may be an image forming apparatus 1 as shown in Fig. 1A.

[0032] Detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. In particular, features presented and described in separate dependent claims may be applied in combination and any advantageous combination of such claims is herewith disclosed.

[0033] Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention. The terms "a" or "an", as used herein, are defined as one or more than one.

[0034] The invention being thus described, it will be obvious that the same may be varied in many ways. Such

variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Claims

1. A method for printing an image using an ink, wherein the method comprises the steps of

   - jetting ink droplets onto a medium creating an image element;
   - selectively jetting an accelerator composition at a border region of the image element;
   - applying a treatment step to the created image element thereby activating the accelerator composition to fixate the border region of said image element.

2. A method according to claim 1, wherein the accelerator composition is jetted after jetting ink droplets.

3. A method according to claim 1, wherein the accelerator composition is jetted before jetting ink droplets.

4. A method according to claim 1, wherein the ink is a UV curable ink.

5. A method according to claim 1, wherein the treatment step comprises the application of UV radiation onto the image element.

6. A method according to claim 1, wherein the accelerator composition comprises a thiol.

7. A method according to claim 1, wherein the accelerator composition comprises a transition metal.

8. A printer comprising

   - An ejection unit configured to in operation eject droplets of an ink composition
   - An ejection unit configured to in operation eject droplets of an accelerator composition
   - A treatment unit for applying a treatment step to a created image element thereby activating the accelerator composition to fixate the border region of an image element
   - A control unit configured to perform the method according to any of the claims 1-7.

9. A printer according to claim 8, wherein the treatment unit for applying a treatment step comprises a UV radiation source.

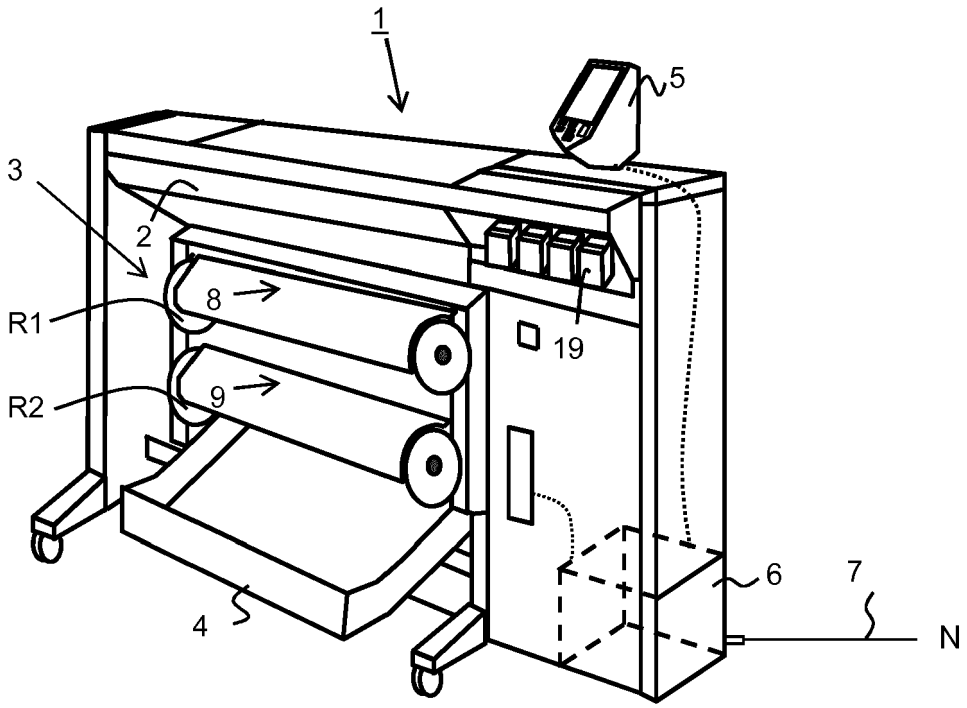

FIG. 1A

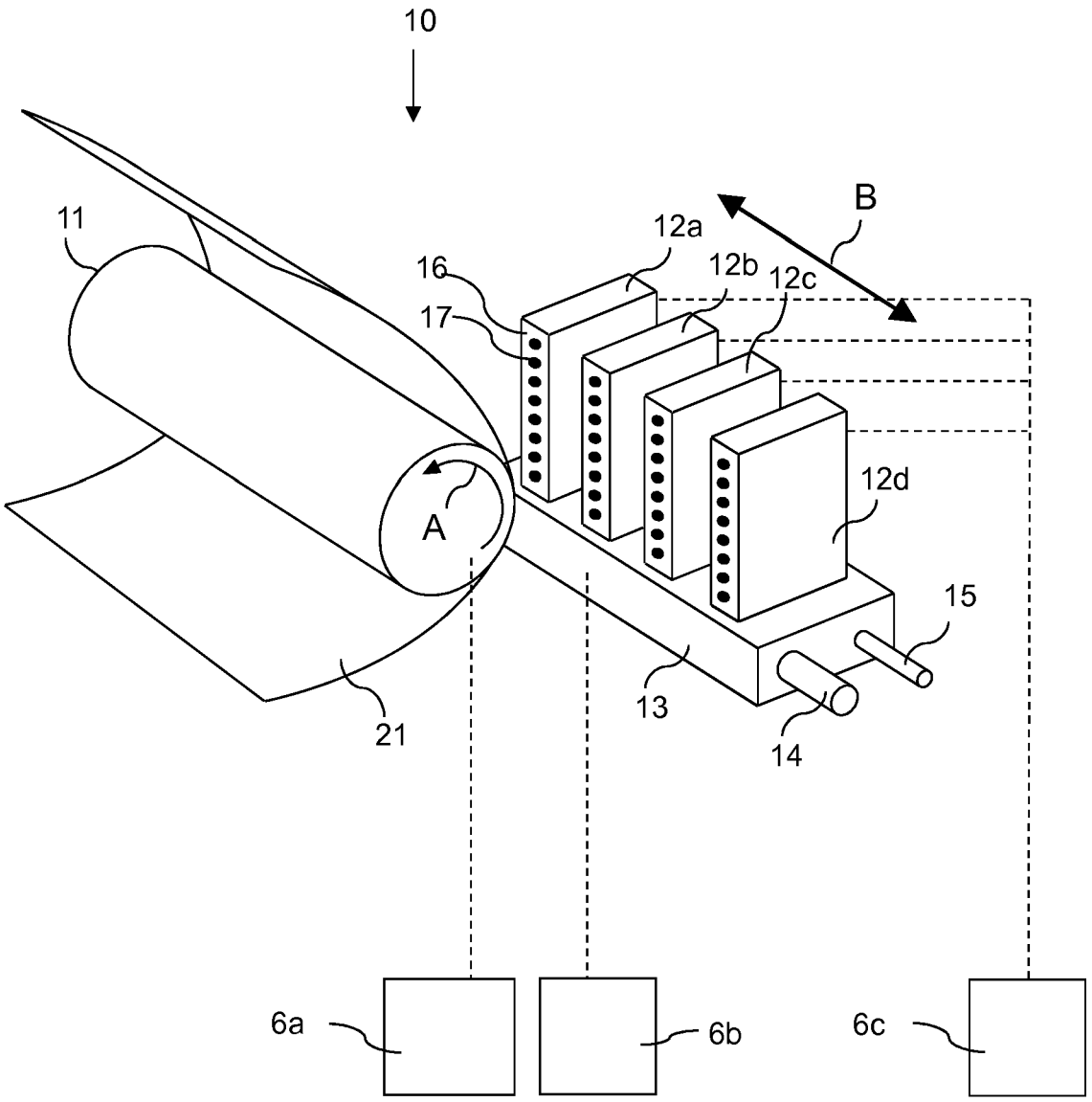

FIG. 1B

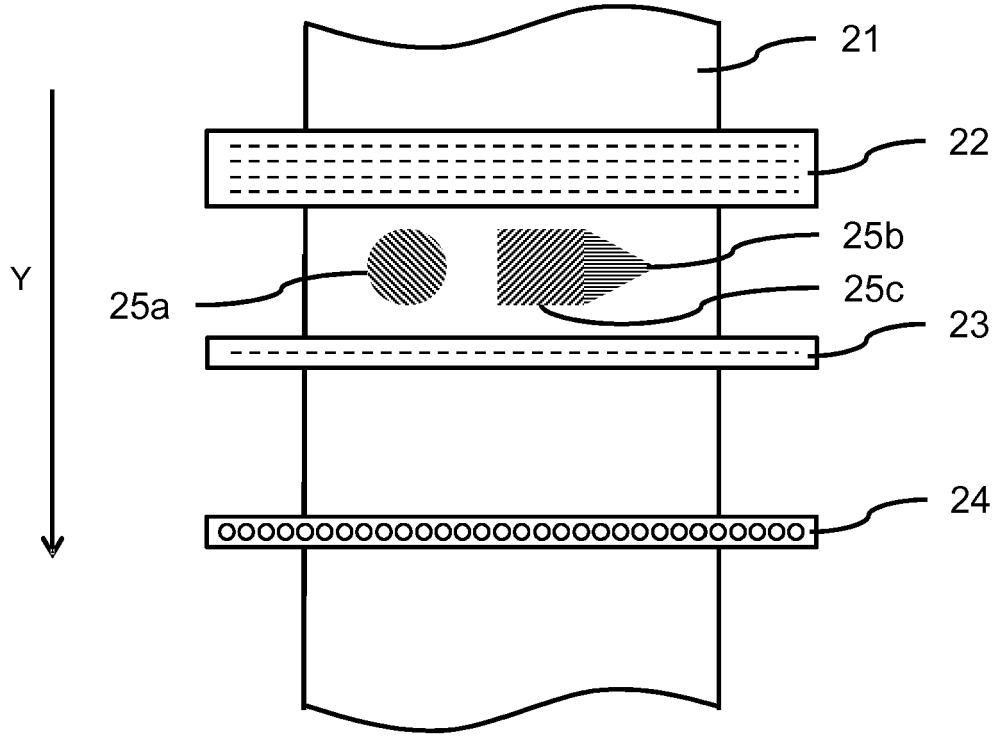

FIG. 2A

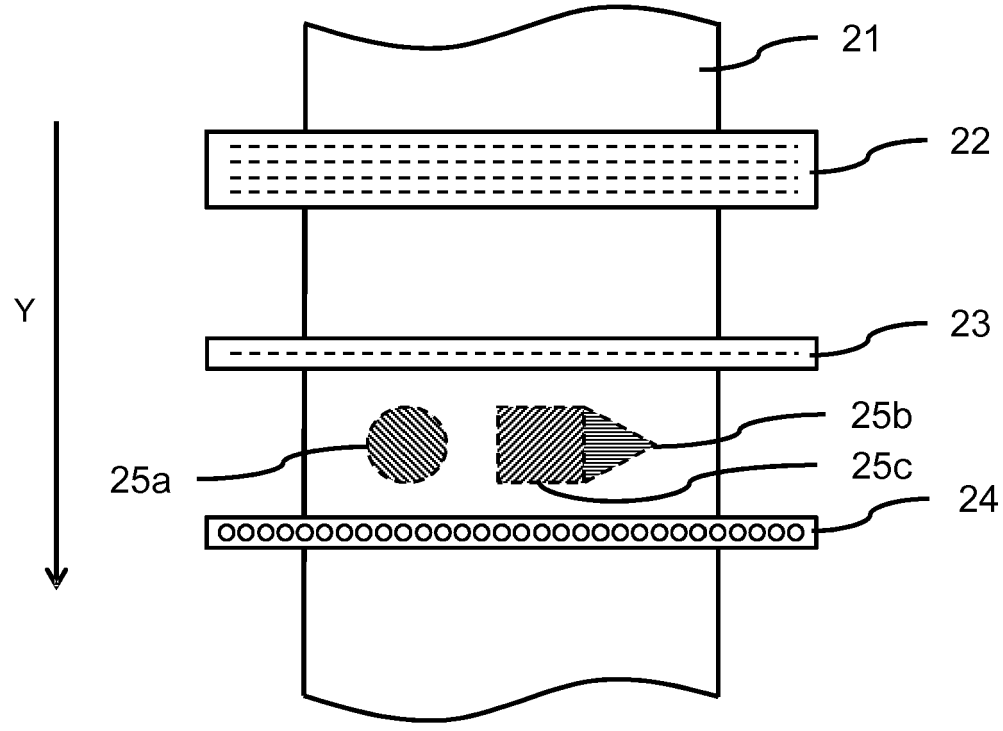

FIG. 2B

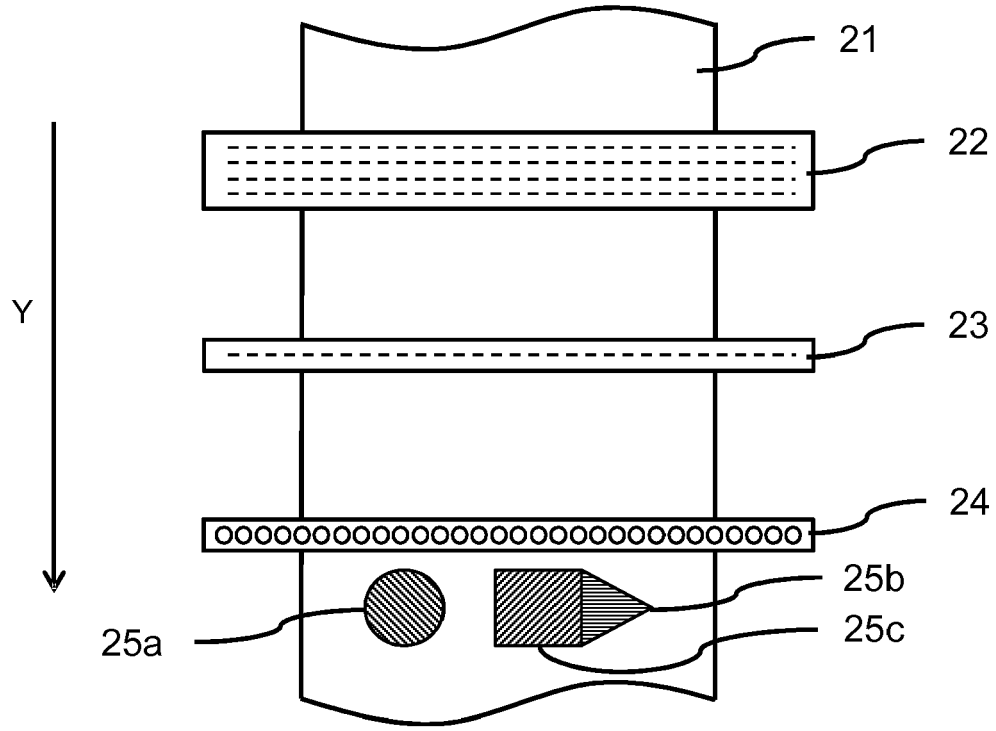

FIG. 2C

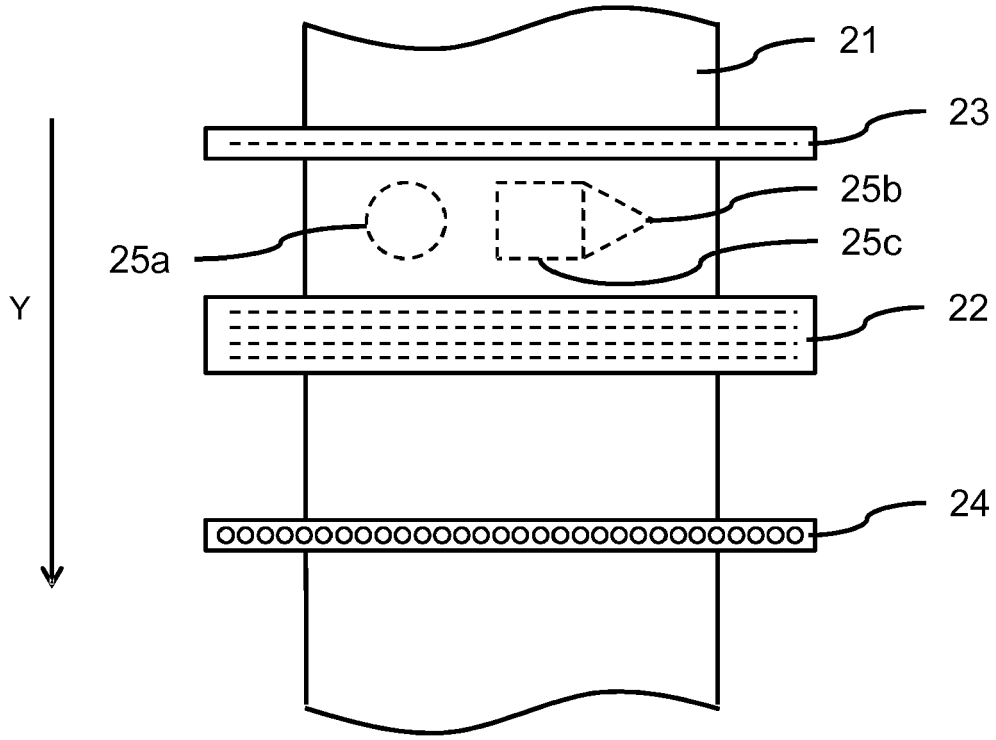

FIG. 3A

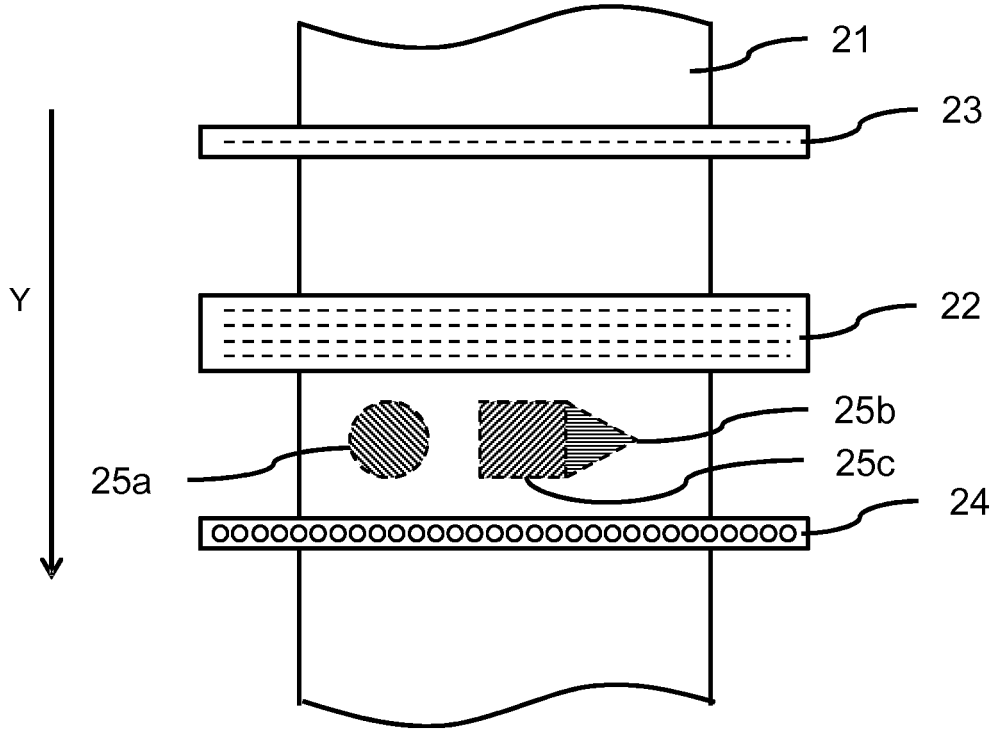

FIG. 3B

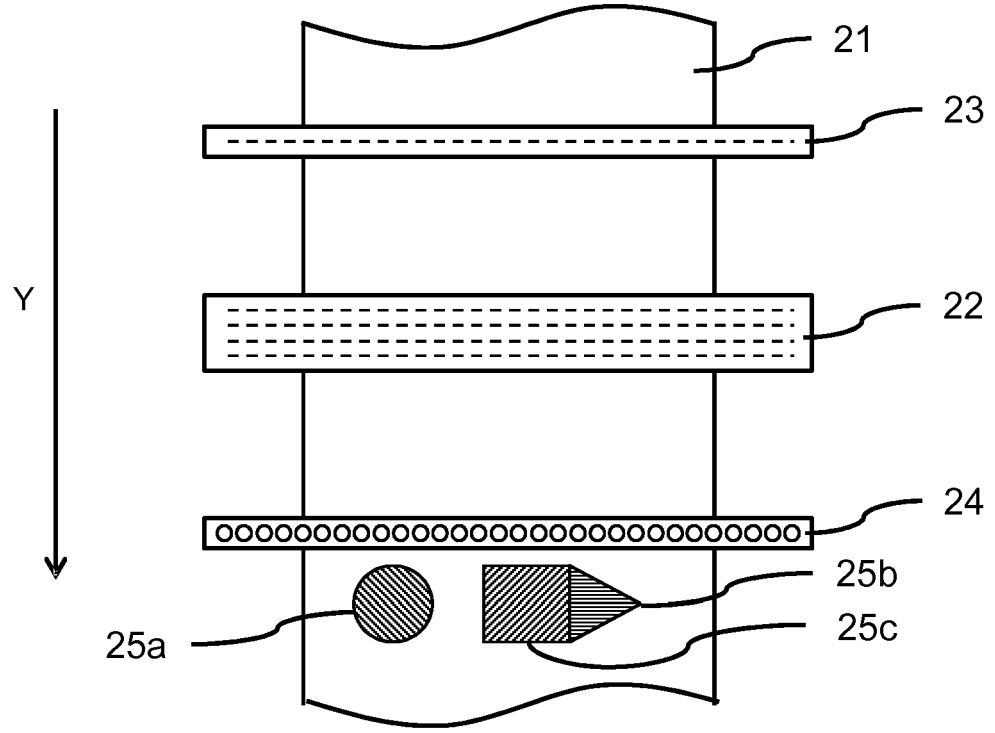

FIG. 3C

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EUROPEAN SEARCH REPORT

Application Number
EP 18 19 8201

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	US 2011/211014 A1 (IRITA KIYOSHI [JP]) 1 September 2011 (2011-09-01) * paragraphs [0003], [0009] - [0017] * * paragraphs [0039] - [0047] * * paragraphs [0153] - [0162] * * paragraphs [0172] - [0189] * * claims 1-7; figure 1 *	1-5,7-9 6	INV. B41M5/00 B41M7/00 B41J11/00
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			TECHNICAL FIELDS SEARCHED (IPC) B41J B41M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 January 2019	Bacon, Alan

CATEGORY OF CITED DOCUMENTS

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