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(54) **METHOD AND SYSTEM FOR NOZZLE COMPENSATION IN NON-CONTACT MATERIAL DEPOSITION**

VERFAHREN UND SYSTEM FÜR DÜSENAUSGLEICH BEI BERÜHRUNGSFREIER
MATERIALABSCHIEDUNG

PROCÉDÉ ET SYSTÈME DE COMPENSATION DE BUSE DANS UN DÉPÔT DE MATIÈRE SANS
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Description

BACKGROUND OF THE INVENTION

[0001] Non-contact material deposition printing is an appealing method for patterning and depositing materials in the printed electronics and solar cell industries. For example, forming conductive lines by directly depositing conductive materials on the back or front surface of the solar cell to provide a conduction path for the charge generated by the cell may increase the efficiency of the solar cell as well as the productivity of mass-manufacturing.

[0002] Deposition printing techniques, such as ink jet printing or aerosol printing involves depositing droplets of print material from nozzles by moving a print head and a substrate relative to one another along a printing direction. One of the problems associated with deposition printing is faulty nozzles that may stop jetting or may jet poorly. Accordingly, a faulty nozzle may result in uneven conductive lines which may lead to inefficient or inoperative solar cells.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] The subject matter regarded as the invention is particularly pointed out and distinctly claimed in the concluding portion of the specification. Document WO 2008/065657 defines the preamble of the first claim. The invention, however, both as to organization and method of operation, together with objects, features and advantages thereof, may best be understood by reference to the following detailed description when read with the accompanied drawings in which:

[0004] Fig. 1 shows an exemplary printing system according to embodiments of the invention;

[0005] Fig. 2 shows printing units having redundant nozzles and positioned parallel to the print direction helpful in demonstrating embodiments of the invention; and

[0006] Fig. 3 is a flowchart diagram illustrating a method for printing according to some embodiments of the present invention.

[0007] It will be appreciated that for simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0008] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will be understood by those of ordinary skill in the art that the in-

vention may be practiced without these specific details. In other instances, well-known methods, procedures, components, modules, units and/or circuits have not been described in detail so as not to obscure the invention.

[0009] Embodiments of the invention may be applicable to a variety of printing systems and methods. For the sake of clarity and simplicity exemplary embodiments and references of non-contact material deposition systems will mostly be for the application of fabrication of conducting metal lines for solar cells using an inkjet system. However, the scope of the invention is not limited by such exemplary embodiments and may be applied to other deposition systems, such as an aerosol jet deposition system or a dispenser and to other applications, such as graphics, press, mass media, packaging, electronics and others.

[0010] The invention and embodiments thereof are directed to a system and method for inspection of print nozzles while a print process or a print job is in progress and replacing actively printing nozzles as needed. According to the invention, the system comprises redundant print heads or printing units such that the number of print heads is higher than the number of print head required to perform a desired printing task. At any given time during printing a portion of the heads may be active while the remaining print head(s) may be redundant.

[0011] According, while a print process is in progress, a first subset selected from a plurality of print heads installed in a system would be designated to deposit material on a substrate, a second, different subset of print heads may be subjected to, or undergo a maintenance procedure. For example, while a first print head is actively depositing material on a substrate, a second print head may be relocated from a printing area or zone to an inspection, service or maintenance area. While the second print head is being inspected, serviced, repaired or otherwise subjected to a maintenance procedure, the first print head may continue to print and/or deposit material.

[0012] In some embodiments, the method may include printing lines on a substrate, for example printing contact lines on a semiconductor wafer by depositing material from a printing unit having nozzles arranged in one or more rows. According to the invention, the printing unit may comprise redundant nozzles. The number of nozzles in a printing unit is larger than the number of nozzles needed to accomplish a desired printing task, for example printing a line at a desired resolution. At any given time during printing, a portion of the nozzles within a printing unit is active while the remaining nozzles are redundant or inactive. The printing is done only by nozzles designated as active nozzles while the remaining nozzles are designated as inactive nozzles. Within a particular row, material may be selectively deposited

[0013] The method may further include moving the printing unit to an inspection zone while continuing the printing with active nozzles of another printing unit, which may perform the tasks of the former printing unit. In the

inspection zone the nozzles are inspected and one of the active nozzles may be identified as a faulty nozzle. According to some embodiments, the inspection may be done at the printing zone without moving the printing unit to the inspection zone.

[0014] Then, the identified faulty nozzle may be designated as inactive and one of the previously designated as inactive nozzles may become an active nozzle to replace the faulty nozzle. The method may further include moving the printing unit back from the inspection zone to the printing zone and continue printing with that unit such that the new active nozzle would replace the faulty nozzle.

[0015] According to embodiments of the invention, after all the nozzles are inspected in the inspection zone or the printing zone, the system may analyze the inspection data and may choose a best set of nozzles to be the active nozzles based on predetermined considerations. Then, the chosen nozzles may be designated or specified as active nozzles while the remaining nozzles of the printing unit would be designated as inactive. Determining the best set of nozzles may be based on a required drop-let size, stability of jetting and/or choosing nozzles having substantially similar deviation of their jetting direction from a normal to the nozzle plate (orifice plate). Other parameters may be taken into consideration for choosing the best set of nozzles without departing from the scope of the invention.

[0016] Reference is made to Fig. 1 showing a high-level block diagram of an exemplary printing system according to exemplary embodiments of the invention. The exemplary system, denoted system 100 may be capable of executing continuous high speed, high volume print jobs without frequently stopping for maintenance or inspection. It will be noted that system 100 may be applicable to a variety of printing systems, e.g., inkjet or aerosol dispensing systems. System 100 may include printing units or print heads 105A-105F, a printing zone 110, such as a conveyor or platform (not shown) defining the width of a print area, on which print media, such as semiconductor wafers may be placed and a service zone 125, in which maintenance and inspection of the printing units and their nozzles may take place.

[0017] Service zone 125 may include one or more maintenance stations to perform various maintenance operations to the printing units. Although only six exemplary printing units are shown, any applicable number of printing units may be used without departing from the scope of the invention. The number of printing units is determined such that at least one printing unit is redundant. The redundancy enables the simultaneous inspection of non-active nozzles when active nozzles continue with the printing process. Accordingly, at least one printing unit from units 105A - 105F may be capable of independently moving between printing zone 110 and service zone 125 while the other printing units remain at the printing zone and continue with the printing process. Service zone 125 may be near or in close proximity to printing

zone 110. According to some embodiments of the invention, printing units 105A-F may be mounted on rails such that they may be moved from printing zone 110 to service zone 125. Any other transport units or mechanisms may be used without departing from the scope of the invention.

[0018] Each printing unit 105A-F comprises nozzles 106 arranged in one or more rows. In the exemplary illustration of Fig. 1, each row has eight nozzles arranged in parallel to the printing or scanning direction X. However, it will be appreciated by those skilled in the art that each row may include tens or hundreds of nozzles. Each row includes redundant nozzles for substitution of faulty nozzles upon detection. A faulty nozzle may be, for example, a clogged nozzle that cannot jet any material, a weak or partially clogged nozzle that can jet only a portion from the desired amount of material or a nozzle that jet in a direction that strongly deviates from the direction of jetting of the majority of the nozzles.

[0019] Printing units 105A-C may be positioned in proximity to printing zone 110 such that the rows would be parallel to the print direction X. If the substrate is moved by a conveyor, the printing direction may be represented by the direction of advance of the substrate. In such a configuration, each row may print a single metalization line in a direction parallel to the print direction in one scan. Other setups or configurations of the printing unit with respect to the print direction are possible according to other embodiments of the invention.

[0020] System 100 may further include a controller 115 to control the printing process and an image acquisition unit 120 coupled to controller 115. According to embodiments of the invention, controller 115 may perform, or be involved in, tasks or functions such as, but not limited to, coordination, configuration, scheduling, arbitration, supervising, operation and/or management of components of system 100 and their operations. For example, controller 115 may control the movement of printing units 105A-F and the printed objects in printing zone 110. Controller 115 may comprise any required or suitable hardware, software, firmware or a combination thereof. For example, controller 115 may be a computing device comprising a controller and/or central processing unit (CPU), a memory and input and output units.

[0021] Image acquisition unit 120 may comprise a detector or imaging device 121, such as camera or charge coupled device (CCD) to inspect the status and condition of the nozzles by acquiring, for example, images of drop-lets of material that exits the nozzles. Any other suitable visual detector or any other method of identifying the status of the nozzles may be used. Image acquisition unit 120 may further comprise an image processing unit 122 to analyze the images and determine the current status of the inspected nozzles and storage 123 to store data related to the status of the nozzles.

[0022] According to embodiments of the invention, detector 121 may be coupled to a dedicated computing and storage device for processing and storing the captured images or alternatively controller 115 may perform these

operations. According to embodiments of the invention, a pulsed light source, such as a pulsed laser source or a pulsed light emitting diode (LED) may be coupled to detector 121 to enable imaging of droplets being deposited from the nozzles. Controller 115 may further control and manage the inspection procedure, for example coordinating the ejection of droplets, the light pulses and the operation of the camera.

[0023] Reference is now made to Fig. 2, which illustrates an array of printing units having redundant nozzles and positioned parallel to the print direction to demonstrate embodiments of the invention. Printing units 210, 220 and 230 may be used to print conductive lines on a semiconductor wafer in the production of solar cells. According to embodiments of the invention, during printing, a first subset of nozzles may be designated as active nozzles, for example, nozzles 224-228 may be designated as active. A second subset of nozzles within printing unit 220, for example, nozzles 221-223 may be designated as inactive. Upon identifying that a nozzle, for example, nozzle 225 is defective, the defective nozzle may be substituted by any one of the inactive nozzles 221-223. For example, nozzle 225 may be re-designated as inactive and nozzle 222 may be re-designated as active.

[0024] According to embodiments of the invention, while a print process is in progress and while one or more printing units defining a first subset of printing units is actively depositing, another one or more printing units defining a second subset of printing units may move to service zone 125 for maintenance and/or inspection. Further, if desired, the status of at least one pair of nozzles may be interchanged such that the previously active nozzle would become inactive and the previously inactive nozzle would become active.

[0025] The printing units relocated to service zone 125 may be inspected, serviced and configured. For example, nozzles may be inspected by acquiring images of droplets dispensed or ejected by nozzles of the inspected unit. The images may then be analyzed by image processing unit 122. Based on the analysis, faulty nozzles may be identified and replaced by redundant nozzles. Further, various working parameters may be modified or verified. For example, based on the inspection of a nozzle, working parameters such as pressure, temperature or voltage may be modified.

[0026] Referring back to Fig. 1, image processing unit 122 may receive images from detector 121 and process such images by applying any suitable image processing techniques. For example, analysis of shape, trajectory and velocity of jetted droplets may be performed by the image processing unit. For example, image processing may be used to determine a condition of a nozzle based on an image of droplets being ejected from the nozzle. Another example may be comparing two or more images, possibly acquired over a predefined period of time. By comparing or otherwise relating images, various conditions, faults or other aspects of a nozzle may be deter-

mined. For example, degradation in the performance of a nozzle may be detected by comparing consecutive or successive images.

[0027] While a video camera may provide images related to visible light, other images may be produced. For example, detector 121 may be an infrared camera that may record temperatures, thus providing a temperature distribution of ejected ink or aerosol. While as described herein, imaging device or detector 121 may be placed at the service area, other configurations are possible. For example, one or more cameras may be placed near, around or in proximity of a printing area, e.g., area 110. Such cameras may obtain images during the printing process of nozzles depositing material onto a test substrate.

[0028] Storage system or unit 123 may receive and store images acquired by detector 121 and/or obtained from a different source, e.g., a remote server or a removable storage media such as a compact disk (CD) or memory chip. For example, reference images of a desired ejection may be loaded into or otherwise stored in a storage device and may be used for comparing with or otherwise relating to images acquired by detector 121. A reference image may contain an image of an ideal, otherwise desirable ejection or deposition and thus may be used, for example by comparing it to a second image in order to determine if an injection imaged in the second image is acceptable or otherwise determine a quality of the ejection or other functional parameters related to the nozzle from which the imaged droplet has jetted.

[0029] It should be appreciated by those skilled in the art that the redundancy of the printing unit or print heads may enable dynamically selecting the print heads that participate in a print process. Accordingly, redundant, spare, unused or idle print heads may exist and/or be available during a print process. Such redundant print heads may enable dynamic replacement of print heads while a print process is ongoing, active or in progress. For example, if a first print head is active, e.g., actively participating in a print process by depositing material on a media, needs, or is selected to be serviced or inspected, a second, inactive, idle or redundant print head may replace the first print head by being made active. Accordingly, the first print head, now being replaced, may be made inactive and may further be inspected, serviced or be otherwise subjected to a maintenance procedure.

[0030] According to embodiments of the invention, the printing units or print heads is equipped with redundant nozzles. For example, a print head that may require one hundred (100) nozzles in order to perform its intended tasks may be equipped with five hundred (500) nozzles. Accordingly, only a subset of nozzles fitted, included or installed in a print head may actively participate in a print process, e.g., actually eject material onto a surface or media. According to embodiments of the invention, redundancy of nozzles as described herein may enable dynamically selecting or designating a subset of nozzles as active. Such redundancy may further enable replacing

active nozzles by inactive ones. For example, upon determining that a first nozzle in a print head needs to be replaced or serviced, e.g., due to a malfunction or as part of a scheduled or periodic maintenance routine, a second, inactive or redundant nozzle may be selected, made active, and may replace the first nozzle by ejecting material onto a surface or media.

[0031] Reference is made to Fig. 3 showing a flowchart diagram illustrating a method for printing according to some embodiments of the present invention. As shown by block 310, the method may include commencing a print process using a first printing unit or print head. For example, information in a print file may be provided to a printing system such as system 100 described in Fig. 1. Provided with such information, controller 115 may cause a conveyor to locate wafers such that a subset of nozzles, designated as active nozzles in both printing units 230 and 220 may deposit conductive material on them. Based on information in such print file, controller 115 may control the nozzles and printing units such that material is deposited according to specifications or parameters in the print file.

[0032] As shown by block 320, the method may include moving the one or more printing units, for example printing unit 220 to a service zone. During the time that the printing unit is being inspected and/or serviced at the service zone, another printing unit, such as printing unit 210 that was previously redundant may become active so that the printing process may continue with printing units 210 and 230. As shown by block 330, the method may include inspecting the nozzles of printing unit 200 and identifying one or more nozzles, for example nozzle 225 as faulty or defective nozzle.

[0033] The method may include determining whether the fault can be repaired. For example, if a total obstruction of a nozzle's orifice is detected, a procedure may exist to remove the obstructions from the orifice thus repairing the fault. Other detected faults may be such that require a complex, possibly manual procedure in order to be fixed. Classifying a fault as one that may be handled or repaired immediately or while a print process is in progress may be according to various parameters and/or configurations. If the fault may be repaired, flow may include servicing the nozzle. For example, the working parameters may be modified or an automated purging procedure may be executed.

[0034] As shown by block 335, the method may include choosing a best set of nozzles as best nozzles based on the inspection. Accordingly, the method may include designating a faulty nozzle as inactive when repair is impossible or undesirable. Nozzles identified as inactive may not participate in the printing process until their status is changed to "active". As shown by block 340, the method may comprise designating the nozzles of the chosen set as active and the faulty nozzles and remaining nozzles of the printing unit as inactive. For example, the method may include designating a nozzle, from the same row of the newly faulty nozzle that was previously designated

an inactive nozzle as active. For example, after determining that nozzle 225 is faulty, a redundant nozzle that was previously inactive and did not participate in the printing process, such as nozzle 223 may be designated as an active nozzle that would replace the faulty nozzle 225.

[0035] While as described herein, a first, faulty nozzle may be designated as inactive and a second, inactive nozzle may be designated as active in order to compensate for the faulty nozzle, other scenarios are possible. For example, nozzles within the same printing unit and possibly the same row may be replaced based on a pre-defined schedule. For example, in order to avoid drying of ink in nozzles, nozzles may be designated as active or inactive periodically. While in some embodiments a first nozzle may be replaced by a second nozzle, other combinations are possible. For example, a faulty nozzle may be replaced by two redundant nozzles. For example, such two nozzles may be instructed such that their combined operation is the same as an expected operation of the faulty, replaced nozzle.

[0036] As shown by block 345, the method may include after the inspection is over, moving the first printing unit back to the printing zone. As other print heads may be printing at such time, printing unit 220 may replace, for example, printing unit 210 in performing the ongoing print process and printing unit 210 may be moved to the service area for inspection. Alternatively, printing unit 220 may replace, for example, printing unit 230 in performing the ongoing print process and printing unit 230 may be moved to the service area for inspection. Accordingly, as shown by block 350, the method may comprise ceasing to print with a working printing unit and continuing with the print process using the first printing unit. The first printing unit may be for example, unit 220 in which the newly active nozzle, nozzle 221 replaces the previously used and now faulty nozzle 225.

[0037] Embodiments of the invention may include an article such as a computer or processor readable medium, or a computer or processor storage medium, such as for example a memory, a disk drive, or a USB flash memory, encoding, including or storing instructions, e.g., computer-executable instructions, which when executed by a processor or controller, carry out methods disclosed herein.

[0038] Although embodiments of the invention are not limited in this regard, the terms "plurality" and "a plurality" as used herein may include, for example, "multiple" or "two or more". The terms "plurality" or "a plurality" may be used throughout the specification to describe two or more components, devices, elements, units, parameters, or the like.

[0039] Unless explicitly stated, the method embodiments described herein are not constrained to a particular order or sequence. Additionally, some of the described method embodiments or elements thereof can occur or be performed at the same point in time or overlapping points in time. As known in the art, an execution of an executable code segment such as a function, task,

sub-task or program may be referred to as execution of the function, program or other component.

[0040] Although embodiments of the invention are not limited in this regard, discussions utilizing terms such as, for example, "processing," "computing," "calculating," "determining," "establishing," "analyzing," "checking," or the like, may refer to operation(s) and/or process(es) of a computer, a computing platform, a computing system, or other electronic computing device, that manipulate and/or transform data represented as physical (e.g., electronic) quantities within the computer's registers and/or memories into other data similarly represented as physical quantities within the computer's registers and/or memories or other information storage medium that may store instructions to perform operations and/or processes.

[0041] While certain features of the invention have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

Claims

1. A method of printing, the method comprising:

printing in a printing zone using a first printing unit (220) having nozzles, a first portion of the nozzles is designated as active nozzles (224-228) and a second portion of the nozzles is designated as inactive nozzles (221-223), wherein the printing is done by selectively depositing material from the active nozzles of the first printing unit;
stopping the printing with the first printing unit while continuing the printing with active nozzles of a second printing unit (210, 230),
inspecting the nozzles of the first printing unit;
choosing a new set of active nozzles based on inspection results; and
continuing the printing using the first printing unit (220) with the new set of active nozzles;
characterised in that the nozzles are arranged in a row having a direction parallel to the scanning direction.

2. The method of claim 1 comprising:

moving the first printing unit to an inspection zone prior to inspecting; and
moving the first printing unit back to the printing zone for continuing the printing.

3. The method of claim 1, wherein printing comprises printing a line in a scanning direction.

4. The method of claim 1 comprising:

identifying one of the active nozzles of the first printing unit as a faulty nozzle;
designating the faulty nozzle as inactive and
designating one of the inactive nozzles of the first printing unit as a new active nozzle, so as the new active nozzle replaces the faulty nozzle.

5. The method of claim 1, wherein inspecting comprises:

acquiring images of ejections of droplets performed by the nozzles of the first printing unit; and
identifying the faulty nozzle based on an analysis of the images.

6. The method of claim 5, wherein the analysis comprises determining the size of droplets and the size of deviation of a jetting direction from a predetermined direction.

7. The method of claim 1, wherein depositing is depositing an electrically conductive material on one of a printed card board or a semiconductor wafer to produce metallization conduction lines.

8. The method of claim 1, wherein the new set of active nozzles is chosen based on a required droplet size.

9. The method of claim 1, wherein the new set of active nozzles is chosen based on the degree of stability of jetting from the nozzles.

10. The method of claim 1, wherein the new set of active nozzles is chosen based the jetting direction of the nozzles.

11. The method of claim 1 comprising:

inspecting at least a portion of the nozzles; and
analyzing inspection data.

12. The method of claim 11, wherein analyzing the inspection data comprises determining the size of droplets ejected from the nozzles and the size of deviation of a jetting direction from a predetermined direction.

Patentansprüche

1. Druckverfahren, wobei das Verfahren folgendes umfasst:

das Drucken in einer Druckzone unter Verwendung einer ersten Druckeinheit (200) mit Düsen,

- wobei ein erster Abschnitt der Düsen als aktive Düsen (224 - 228) vorgesehen ist, und wobei ein zweiter Abschnitt der Düsen als inaktive Düsen (221 - 223) vorgesehen ist, wobei das Drucken durch selektive Materialabscheidung aus den aktiven Düsen der ersten Druckeinheit erfolgt;
- das Anhalten des Druckens mit der ersten Druckeinheit, während das Drucken mit den aktiven Düsen einer zweiten Druckeinheit (210, 230) fortgesetzt wird;
- das Überprüfen der Düsen der ersten Druckeinheit;
- das Auswählen einer neuen Gruppe aktiver Düsen auf der Basis der Überprüfungsergebnisse; und
- das Fortsetzen des Druckens unter Verwendung der ersten Druckeinheit (220) mit der neuen Gruppe aktiver Düsen;
- dadurch gekennzeichnet, dass** die Düsen in einer Reihe mit einer parallelen Ausrichtung zur Abtastrichtung angeordnet sind.
2. Verfahren nach Anspruch 1, wobei dieses folgendes umfasst:
- das Bewegen der ersten Druckeinheit an eine Überprüfungszone vor der Überprüfung; und
- das Bewegen der ersten Druckeinheit zurück zu der Druckzone zum Fortsetzen des Druckens.
3. Verfahren nach Anspruch 1, wobei das Drucken das Drucken einer Linie in einer Abtastrichtung umfasst.
4. Verfahren nach Anspruch 1, wobei dieses folgendes umfasst:
- das Identifizieren einer der aktiven Düsen der ersten Druckeinheit als eine fehlerhafte Düse; und das Bestimmen der fehlerhaften Düse als inaktiv und das Bestimmen einer der inaktiven Düsen der ersten Druckeinheit als eine neue aktive Düse, so dass die neue aktive Düse die fehlerhafte Düse ersetzt.
5. Verfahren nach Anspruch 1, wobei das Überprüfen folgendes umfasst:
- das Erfassen von Bildern des Ausstoßes von Tröpfchen, das durch die Düsen der ersten Druckeinheit vorgenommen wird; und
- das Identifizieren der fehlerhaften Düse auf der Basis einer Analyse der Bilder.
6. Verfahren nach Anspruch 5, wobei die Analyse das Bestimmen der Größe der Tröpfchen und der Größe der Abweichung einer Spritzrichtung von einer vor-
- bestimmten Richtung umfasst.
7. Verfahren nach Anspruch 1, wobei es sich bei dem Abscheiden um ein Abscheiden eines elektrisch leitfähigen Materials auf einer gedruckten Leiterplatte oder einem Halbleiterwafer handelt, um leitende Metallisierungspfade zu erzeugen.
8. Verfahren nach Anspruch 1, wobei die neue Gruppe aktiver Düsen auf der Basis einer erforderlichen Tröpfchengröße ausgewählt wird.
9. Verfahren nach Anspruch 1, wobei die neue Gruppe aktiver Düsen auf der Basis des Stabilitätsmaßes des Spritzens aus den Düsen ausgewählt wird.
10. Verfahren nach Anspruch 1, wobei die neue Gruppe aktiver Düsen auf der Basis der Spritzrichtung der Düsen ausgewählt wird.
11. Verfahren nach Anspruch 11, wobei dieses folgendes umfasst:
- das Überprüfen mindestens eines Teils der Düsen; und
- das Analysieren der Überprüfungsdaten.
12. Verfahren nach Anspruch 11, wobei das Analysieren der Überprüfungsdaten das Bestimmen der Größe der Tröpfchen umfasst, die aus den Düsen ausgestoßen werden, sowie der Größe der Abweichung einer Spritzrichtung von einer vorbestimmten Richtung.

Revendications

1. Procédé d'impression, le procédé comprenant les étapes consistant à :
- imprimer dans une zone d'impression en utilisant une première unité d'impression (220) ayant des buses, une première partie des buses étant désignée comme buses actives (224-228) et une seconde partie des buses étant désignée comme buses inactives (221-223), dans lequel l'impression est effectuée en déposant de façon sélective de la matière à partir des buses actives de la première unité d'impression ;
- arrêter l'impression avec la première unité d'impression tout en continuant l'impression avec les buses actives d'une seconde unité d'impression (210, 230) ;
- inspecter les buses de la première unité d'impression ;
- choisir un nouvel ensemble de buses actives en fonction des résultats d'inspection ; et
- continuer l'impression en utilisant la première

- unité d'impression (220) avec le nouvel ensemble de buses actives ;
caractérisé en ce que les buses sont agencées dans une rangée ayant une direction parallèle à la direction de balayage. 5
2. Procédé selon la revendication 1, comprenant les étapes consistant à :
- déplacer la première unité d'impression vers une zone d'inspection avant l'inspection ;
 et
 déplacer la première unité d'impression de retour vers la zone d'impression pour continuer l'impression. 10
3. Procédé selon la revendication 1, dans lequel l'impression comprend l'étape consistant à imprimer une ligne dans une direction de balayage. 20
4. Procédé selon la revendication 1, comprenant les étapes consistant à :
- identifier l'une des buses actives de la première unité d'impression comme une buse défectueuse ;
 désigner la buse défectueuse comme inactive et désigner l'une des buses inactives de la première unité d'impression comme nouvelle buse active, de sorte que la nouvelle buse active remplace la buse défectueuse. 25 30
5. Procédé selon la revendication 1, dans lequel l'inspection comprend les étapes consistant à : 35
- acquérir des images d'éjections de gouttelettes effectuées par les buses de la première unité d'impression ; et
 identifier la buse défectueuse en fonction d'une analyse des images. 40
6. Procédé selon la revendication 5, dans lequel l'analyse comprend l'étape consistant à déterminer la taille des gouttelettes et la taille de la déviation d'une direction de jet par rapport à une direction prédéterminée. 45
7. Procédé selon la revendication 1, dans lequel le dépôt comprend l'étape consistant à déposer une matière électriquement conductrice sur l'une d'une carte imprimée ou d'une tranche semi-conductrice pour produire des lignes de conduction de métallisation. 50
8. Procédé selon la revendication 1, dans lequel le nouvel ensemble de buses actives est choisi en fonction d'une taille de gouttelettes requise. 55
9. Procédé selon la revendication 1, dans lequel le nou-
- vel ensemble de buses actives est choisi en fonction du degré de stabilité de jet des buses.
10. Procédé selon la revendication 1, dans lequel le nouvel ensemble de buses actives est choisi en fonction de la direction de jet des buses.
11. Procédé selon la revendication 1, comprenant les étapes consistant à :
- inspecter au moins une partie des buses ; et
 analyser les données d'inspection.
12. Procédé selon la revendication 11, dans lequel l'analyse des données d'inspection comprend l'étape consistant à déterminer la taille des gouttelettes éjectées des buses et la taille de la déviation d'une direction de jet par rapport à une direction prédéterminée.

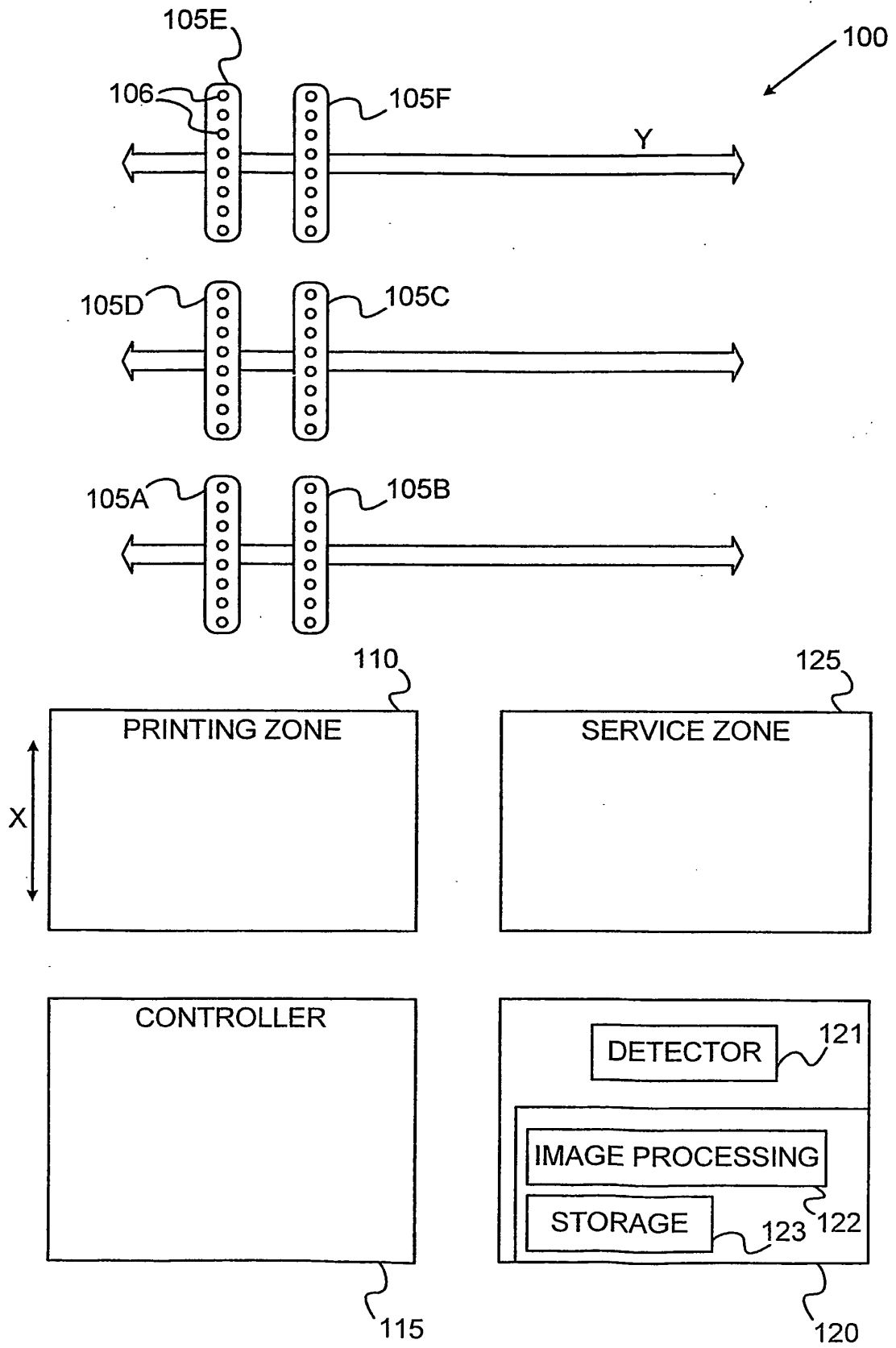
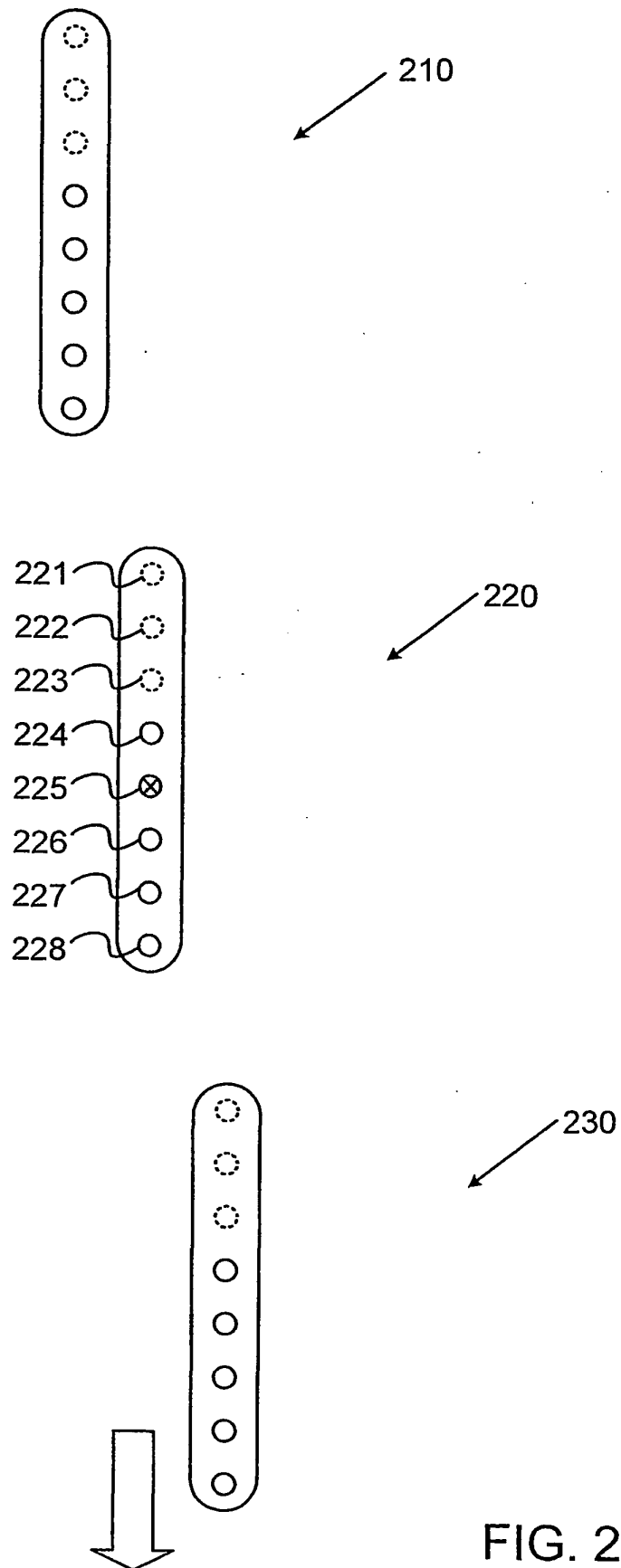


FIG. 1



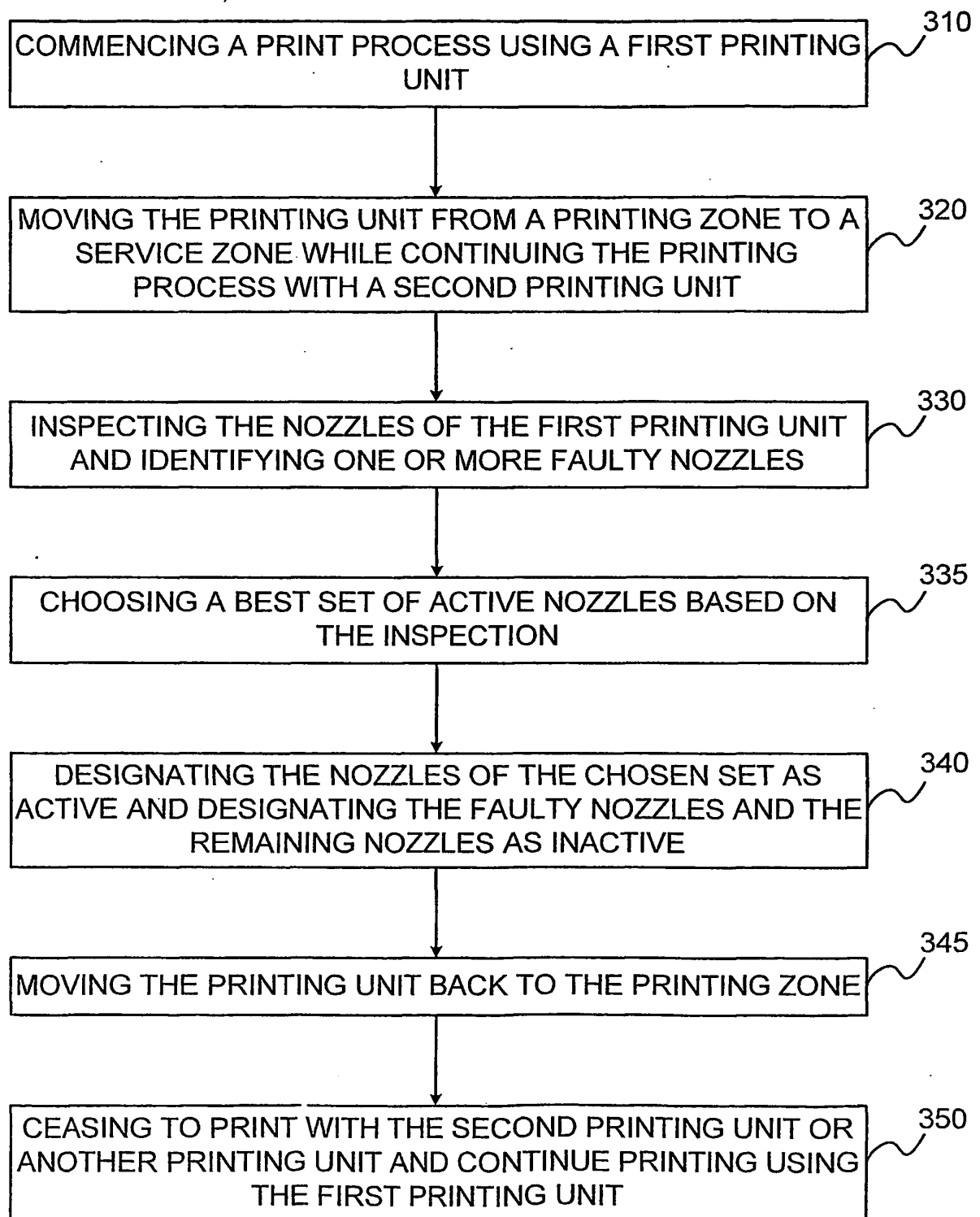


FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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