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(54) METHOD FOR PRODUCTIVE PRINTING ON A SCANNING INKJET PRINTER WITH MULTI-COLOR PRINT HEAD UNITS

(57) A scanning inkjet printer with a staggered configuration of print head units on its carriage is provided. The print head units are structurally similar and comprise multiple nozzle rows. Each nozzle row is provided with its individual marking material supply channel for supplying a specific marking material type to said nozzle row. While a number of print head units are configured for multi-color printing, the marking material supply channels of at least one print head unit are connected to the same marking material supply reservoir, resulting in a mono-color print head. This allows for the parallel deposition of both colors and e.g. white ink in a single pass of the carriage. Productivity and the application range of the printer may thus be extended.

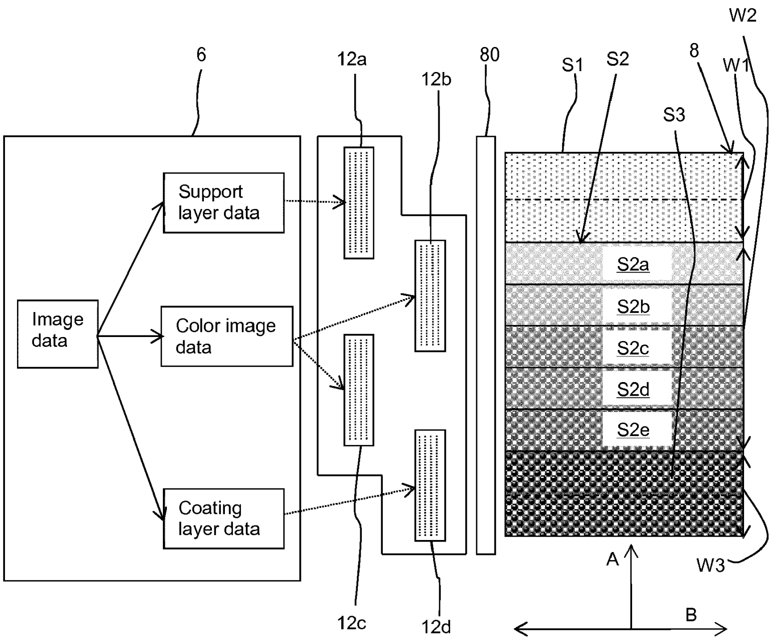

Fig. 4

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Description

FIELD OF THE INVENTION

[0001] The present invention generally pertains to a method for printing with a scanning inkjet printer as well as to a correspondingly configured scanning inkjet printer.

BACKGROUND ART

[0002] A scanning inkjet printer, such as a flatbed or roll printer, generally comprises a medium support surface and a carriage mounted reciprocally moveable in a scanning direction over the medium support surface. The carriage holds a plurality of separate print head units. Each print head unit comprises a plurality of nozzle rows provided in a common nozzle surface. The nozzle rows extend in a non-scanning direction perpendicular to the scanning direction. The nozzle rows may therein be oriented at an angle with respect to the non-scanning direction. The nozzle rows of each print head unit are in fluid communication with a respective marking material supply reservoir for supplying a predetermined marking material type to said nozzle rows. The separate print head units extend in the non-scanning direction in a staggered configuration, such that the nozzle rows of adjacent print head units partially overlap with one another when viewed in the scanning direction. Drawback of such scanning inkjet print head units are that printers equipped therewith are generally preconfigured to print with a predetermined set of marking materials or inks (e.g. CYMK colors). For certain print jobs (printing on dark media, day-night applications) a specialty marking material type such as white ink or varnish may be required, for which specialty marking material type the printer is not configured. The respective modification may not be possible due to size limitations of the print head carriage or may lead to significant downtime of the printer.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a productive scanning inkjet printer with a wide or versatile application range.

[0004] In a first aspect of the present invention, a method for printing on a scanning inkjet printer is provided. The printer comprises a medium support surface and a carriage mounted reciprocally moveable in a scanning direction over the medium support surface. The carriage holds a plurality of separate print head units, each print head unit comprising a plurality of nozzle rows extending in a non-scanning direction perpendicular to the scanning direction. Each nozzle row is in fluid communication to a respective marking material supply reservoir for supplying a predetermined marking material type to said nozzle row, the separate print head units extending in the non-scanning direction in a staggered configuration, such that the nozzle rows of adjacent print head units partially overlap with one another when viewed in the scanning direction. The method comprises the steps of:

- supplying different first marking material types with each a different colorant from a plurality of different first marking material supply reservoirs to respective first nozzle rows of the first print head units, each first marking material supply reservoir holding a single first marking material type, such that each of said first print head units is allowed to simultaneously jet different first marking material types; and
- supplying a further marking material type different from the first marking material types from a further marking material supply reservoir separate from the first marking material supply reservoirs to all nozzle rows of a further print head unit different from the first print head units, such that said further print head unit is allowed to jet said further marking material type from all its nozzle rows.

[0005] The present invention allows the first print head unit of the printer to be configured to jet multiple marking material types, such as CYMK colors. Due to the staggered configuration these first print head units provide a sufficiently wide range of this multi-material type swath to achieve sufficient productivity. The at least one further print head unit is configured to jet the further marking material type from all its nozzle rows. The maximum rate at which the further marking material type may be deposited is greater than that of any of the first marking material types, at least per print head unit or unit area. For example, when four nozzle rows are employed in the first print head unit to jet e.g. CYMK colors, then the further print head unit may jet the further marking material type at maximum four times the maximum rate at which each of the CYMK colors may be deposited individually. The time for forming a portion of the mono-material type layer with the further print head unit is thus shorter than the time for forming a corresponding or same-sized portion with the multi-material type print head units. An additional advantage is that the same type of print head unit may be used for both the first and the further print heads. Making changes in the print head configuration is thus relatively simple as the first and further print head units need not be replaced, but merely the marking material supply connection to the different nozzle rows needs to be rearranged.

[0006] This results in a low-costs yet versatile and productive method for operating an scanning inkjet printer. Thereby the object of the present invention has been achieved.

[0007] More specific optional features of the invention are indicated in the dependent claims.

[0008] In an embodiment, each print head unit comprises for each nozzle row a supply channel extending parallel to said nozzle row for distributing ink from the marking material supply reservoir to all nozzles in said nozzle row. The supply channel distributes the marking material type throughout the print head unit. The print head unit is preferably formed by MEMS manufacturing to achieve the desired nozzle resolution (e.g. 300 DPI or more). Each ink supply channel is connected via a marking material supply line to its respective marking material supply reservoir which is generally remote from the print head unit. Nozzles belonging to a nozzle row are in fluid communication with one another via the supply channel inside the print head unit. The nozzles in a single nozzle row may be positioned in a straight line, a zig-zag arrangement, or a staggered configuration.

[0009] In an embodiment, the further print head unit is positioned in the staggered configuration at least partially non-overlapping the first print head unit, when viewed in the scanning direction. The first print head units define a first print swath of a predetermined width. In said swath a single a portion of an image may be formed by the first marking material types. The width of the first print swath in the non-scanning direction is defined by the overlapping staggered first print head units. Adjacent said first print swath in the non-scanning direction, a further print swath formed of the further marking material type may be deposited by the further print head unit in the same pass of the carriage as the first print swath. Generally, a color image is printed in multiple passes, wherein in each pass a portion of the respective marking material type is deposited. Halftoning is therein generally applied to achieve the desired visual results. Preferably, in between passes the print medium is moved a step (or continuously) in the non-scanning or transport direction. For example, for multi-pass printing in N passes, the image is moved during the N passes, such that the displacement of the print medium is no more than the width first print swath. This may be done by displacing the print medium by a step proportional to the width of the first print swath divided by N. In contrast, the respective portion of the further marking material type layer is preferably deposited in less than the first number N, preferably less than half said number N, and very preferably in a single swath. This is achieved by depositing the further marking material type at a greater rate than the first marking material types. During a pass, the first marking material types are deposited at, at most or no more than, a first maximum or average deposition rate, while during the same pass the further print swath of the further marking material type is deposited along the first print swath at a further deposition rate substantially greater than the first maximum deposition rate. Thereto, all nozzle rows of the further print head unit are applied for jetting the further marking material type in contrast to the first marking material types, which are jetted respectively from a single nozzle row per print head unit. This allows the printer to form a suitable layer of the further marking material type in parallel to printing the first marking material types without slowing productivity with respect to printing only with said first marking material types. For example, an opaque white ink layer may thus be deposited by the further print head unit on a pre-colored or black print medium to allow for color printing while maintaining high productivity.

[0010] In an embodiment, the further print head unit is positioned at an end of the staggered configuration of print head units when viewed along the non-scanning direction. Consequently, the further print swath may then in a single pass be printed parallel and adjacent to the first print swath formed by the different first marking material types. While printing the image with the first marking material types a layer of the further marking material type may thereby be deposited below (e.g. a bottom support layer of white ink) or on top of the image (e.g. a cover layer of varnish or other coating). The further marking material type may thus be printed in parallel with the full-color image, achieving high productivity.

[0011] In an embodiment, the method further comprises the step of curing the deposited further marking material type after its deposition on the print medium. The further marking material type is preferably a fast drying ink or comprises a gellator which renders sufficient viscosity to the further marking material type to allow it to be printed on after deposition, even without curing. Such further marking material types are commonly known, e.g. UV gel inks. Additionally, a curing station may be provided for curing ink deposited by the print head units. Such curing stations are known in the form of e.g. UV emitters. A curing station may be positioned on the carriage itself and/or a curing station support remote from the carriage (e.g. a dedicated curing station carriage). To achieve the desired curing times the intensity of the light from the curing station reaching the jetted marking material types may be configured by any means available to the skilled person, such as high intensity lights or LEDs, mirrors, lenses, or other light focusing means. Curing times may further be shortened by selecting a sufficiently fast UV curable polymer for the marking material types. The curing may further be enhanced by adding suitable additives to the marking material type, such as those commonly known in the state of the art.

[0012] In another embodiment, the method according to the present invention further comprises the steps of:

- jetting a first marking material type in a first pass of the carriage;
- jetting the further marking material type with a deposition rate at least twice, thrice, or four times a maximum deposition rate of the first marking material type in the first pass.

The first marking material type is jetted from at most a single nozzle row of one or more of the first print head units. Each print head unit comprises a number (preferably at least three or four) of marking material supply channels running through the print head unit and fluidly connecting the nozzles of each respective nozzle row to one another. In the first print head units each supply channel is connected to a different marking material supply reservoir via a marking material supply line, such that different first marking material types run through each first print head unit. In contrast, the further marking material type is jetted from all nozzle rows of the further print head unit. The plurality of supply channels in the further print head unit are all connected to the same further marking material supply reservoir. This allows the further print head unit to deposit a single marking material type at a higher rate than a first print head unit. It is noted that the number of first marking material supply reservoirs preferably matches the number of nozzle rows of each print head unit and thus the number of supply channels per print head unit. The further marking material supply reservoir brings the total number of marking material supply reservoir to at least one more than the number of the number of supply channels per print head unit.

In another embodiment, the method according to the present invention further comprises the steps of:

- jetting a first marking material type from no more than a single nozzle row per first print head unit in a first pass of the carriage; and
- jetting the further marking material type from multiple nozzle rows of the further print head unit in said first pass.

[0013] In an embodiment, the method according to the present invention further comprises the steps of:

- a controller receiving print job information defining first image data for forming an image layer with the first marking material types and further image data for forming a further layer of the further marking material type, wherein the image layer and the further layer are designated to be printed overlapping one another;
- the controller controlling the first print head units in correspondence with the first image data to print a portion of the image layer on an area of the print medium in a predetermined first number of passes of the first print head units over said area;
- the controller controlling the further print head unit in correspondence with the further image data to print a portion of the further layer on said area of the print medium in a predetermined further number of passes of the further print head unit over said area, wherein the further number is less than the first number, preferably no greater than half the first number.

When no further marking material type is required for printing an image, the controller operates in a first print mode, wherein an image layer is printed in correspondence to print job information received by the controller. The print job information comprises first image data, which the controller processes into suitable print job execution data. The controller therein determines a number of passes wherein each portion of the image layer is to be printed. The number of passes for such multi-pass printing may be defined by the print job information or determined by the controller by reviewing of the first image data. The first image data substantially defines the print job execution data for applying the first marking material types.

For print jobs requiring the application of the further marking material type, the controller is configured to operate in a further print mode, which allows the simultaneous deposition of the first and further marking material types in a single pass. The first print head units define a first print swath width. The carriage is controlled to move back and forth, such that the area of the print medium is passed through said first print swath width the predetermined first number of times. The image layer is formed in said number of passes. The carriage is moved with respect to the print medium in the non-scanning direction in between passes. Productivity and/or quality determines the predetermined first number of passes for completing portions the first image layer. The width of the further print swath of the further print head unit is preferably smaller, or narrower than the width of the first print swath. In consequence, fewer than the predetermined first number of passes are available for completing portions of the further layer. The controller corrects for this by jetting the further marking material type from all nozzle rows of the further print head unit. This increased deposition rate of the further marking material type with respect to the first marking material type allows the further layer to be completed in less passes than the first image layer. Thereby, a further layer may be formed below or on top of the first image layer in a single print job. For example, for 5-pass printing on a roll printer, the print medium is moved at most one fifth part of the first print swath width. The controller is e.g. configured to control the further print head unit to deposit sufficient ink in no more than half of the first number of predetermined passes, preferably in two passes or even in a single pass.

[0014] In an embodiment, the further marking material type is jetted in the first pass along with the first marking material type. The first print swath defined by the first print head units is adjacent or neighboring the further print swath defined by the further print head unit. In a productive print mode, the first and further print head units are controlled to deposit the first and further marking material types in parallel during a pass of the carriage. Thereby, a swath of further marking material type is formed along a swath of first marking material types on the print medium.

[0015] In an embodiment, the print head units comprises a MEMS manufactured print head structure formed of a plurality of stacked substrates processed to comprise a pressure chamber and an actuator chamber for holding an actuator configured to deform to generate a pressure pulse in the pressure chamber, such that a droplet of an marking material type is jetted from a nozzle in a nozzle row, wherein all print head units comprise identical MEMS manufactured print head structures. To simplify production the structure or design of all print head units in the carriage is the same or even identical. Each print head unit has multiple marking material supply channels. A first print head unit is defined by the marking material supply channel being connected to different marking material supply reservoirs, while all marking material supply channels of the further print head unit are connected to the same marking material supply reservoirs (or separate reservoirs comprising the same further marking material type). Forming the print head units by means of MEMS manufacturing allows for a low costs high resolution print head.

[0016] In an embodiment, the further marking material type is a specialty marking material type, such as white ink, varnish, or primer. White ink may be applied for forming an opaque base layer on colored or dark medium. Similarly primer may be applied for supporting the color marking material types. In the latter examples, the further print head is preferably positioned upstream of the first head units in the non-scanning direction to allow the white ink or primer to be positioned below the colored inks while moving the carriage with respect to the printed medium in a single direction. When e.g. a varnish is applied as the further marking material type, a further print head unit positioned downstream of the first print head units in the non-scanning direction is preferred. It will be appreciated that within the present invention the carriage may hold multiple further print head units.

[0017] In another embodiment, the method according to the present invention further comprises the steps of:

- in a first print mode controlling the firsts print head units to deposit overlapping first swaths formed of the first marking material types to form an image in multiple passes of the carriage; and
- in a further print mode controlling the first print head units to deposit overlapping first swaths formed of the first marking material types to form an image in multiple passes of the carriage, wherein the further print head unit is in each pass controlled to deposit a further swath of the further marking material type parallel to the first swaths, preferably wherein the further swaths of the further marking material type are deposited in for the majority or substantially non-overlapping manner with one another. While the colored first image layer is preferably formed by multi-pass printing with the first print head units, the further layer is preferably deposited in substantially a single pass.

[0018] In a further aspect, the present invention provides a method for printing application images suitable for backlit applications, the method comprising, within a single pass of a carriage support a plurality of the print head units, the steps of:

- printing a multi-color first image layer on a print medium;
- printing a transparent mono-material further layer on a printed portion of the first image layer; and
- printing a multi-color second image layer on a printed portion of the further layer.

Within a single pass of the carriage three different layers are deposited. Thereto, the further print head unit configured for jetting mono-material is preferably positioned between a pair of first print head units configured for multi-material jetting, when viewed in the scanning direction. Preferably, the print medium, the first image layer, the further layer, the second image layer and/or all together are transparent, allowing light to pass from the second image side through all the different layers. This provides an efficient manner of printing so-called day-night applications, which differ in appearance when the dominant light source when viewing the application is ambient light as compared to when the dominant light source is a backlight for transmitting light through all layers of the printed application.

[0019] In another aspect, the present invention provides a scanning inkjet printer comprising a medium support surface and a carriage mounted reciprocally moveable in a scanning direction over the medium support surface, the carriage holding a plurality of separate print head units, each print head unit comprising a plurality of nozzle rows extending in a non-scanning direction perpendicular to the scanning direction, wherein each nozzle row is in fluid communication to a respective marking material supply reservoir for supplying a predetermined marking material type to said nozzle row, the separate print head units extending in the non-scanning direction in a staggered configuration, such that the nozzle rows of adjacent print head units partially overlap with one another when viewed in the scanning direction, wherein:

- nozzle rows of first print head units are respectively in fluid communication to different first marking material supply reservoirs, each first marking material supply reservoir configured to hold a single first marking material type, such that each of said number of said first print head units is allowed to simultaneously jet different first marking material types; and
- nozzle rows of a further print head unit different from the first print head units are in fluid communication to a further marking material supply reservoir configured to hold a further marking material type, such that said further print head units is allowed to simultaneously jet the further marking material type from all its nozzle rows. The printer is configured for performing the above described method.

[0020] In another aspect, the present invention provides an inkjet print head assembly for use in the scanning inkjet printer and method described above.

[0021] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating embodiments of the invention, are given by way of illustration only, since various changes and modifications within the scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying schematical drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

Fig. 1 is a schematic perspective view of a scanning inkjet printer;
Fig. 2 is a schematic perspective view of a scanning inkjet print head assembly for use in the printer in Fig. 1;
Fig. 3A is a schematic top side perspective view of an individual print head for use in the assembly in Fig. 2;
Fig. 3B is a schematic bottom side perspective view of an individual print head for use in the assembly in Fig. 2;
Fig. 4 is schematic representation of a first embodiment of a method for printing on the scanning inkjet printer in Fig. 1 and 2;
Fig. 5A is schematic representation of a second embodiment of a method for printing on the scanning inkjet printer in Fig. 1 and 2;
Fig. 5B is schematic representation of a third embodiment of a method for printing on the scanning inkjet printer in Fig. 1 and 2; and
Fig. 6 is a schematic cross-sectional view of the MEMS manufactured print head unit in Fig. 3A and 3B.

DETAILED DESCRIPTION OF THE DRAWINGS

[0023] The present invention will now be described with reference to the accompanying drawings, wherein the same reference numerals have been used to identify the same or similar elements throughout the several views.

[0024] Fig. 1 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 19. 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 19 to a receiving unit 4 to collect the medium 8, 9 after printing. A storage unit 70 for marking material is provided to hold marking materials. Each marking material for use in the printing assembly 70 is stored in one of a plurality of containers 70a - f arranged in fluid communication with the respective print heads 12a - d for supplying marking material to said print heads 12a - d to print an image on the medium 8, 9. The receiving unit is preferably a take-up roller (not shown but on the rear side of the apparatus 1 in Fig. 1) for winding up the printed medium 8, 9. A receiving tray 4 may further be provided for supporting cut sheets of printed medium 8, 9. Optionally, processing means for processing the medium 8, 9 after printing may be provided, e.g. a post-treatment device such as a coater or cutter. 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. The connection to the network 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. 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.

[0025] Fig. 2 shows an inkjet printing assembly 11. The inkjet printing assembly 11 comprises a medium support surface 12 to support the medium 8, 9 during printing. The medium support surface 12 in Fig. 2 is provided on a platen 12 in the form of a flat plate. The medium support surface 51 is preferably provided with suction holes 50 for at least temporarily holding the medium 8, 9 in a fixed position with respect to the medium support surface 51. The inkjet printing assembly 11 comprises print heads 12a - 12d, mounted on a scanning print carriage 13. The scanning print carriage 13 is guided by a suitable guide 15 to move in reciprocation in the main scanning direction B. Each print head 12a - 12d comprises a nozzle layer or plate (16 in Fig. 3A), which nozzle layer 16 is provided with a plurality of nozzles 50. The print heads 12a - 12d are configured to eject droplets of marking material onto the medium 8, 9. The underpressure at the medium support surface 51, the carriage 13 and the print heads 12a - 12d are controlled by suitable controlling means 6.

[0026] The print medium 8, 9 is supplied in web form and may be composed of e.g. paper, cardboard, label stock, coated paper, plastic or textile. The print medium 8, 9 is moved by means a transport roller or pinch (not shown) in the transport or sub-scanning direction A over the platen 51 along four print heads 12a - 12d and provided with a fluid marking material.

[0027] 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 51, such as to enable scanning of the medium 8, 9 in the main scanning direction B. Any number of print heads 12a - d may be employed. At least one multi-color print head capable of applying different colors of marking materials is placed on the scanning print carriage 13, for example print head 12b - 12c. The multi-color print heads 12b-c comprise multiple nozzle rows 50a - d, one for each of the applied colors, usually cyan, yellow, magenta, and black (CYMK) is present. All nozzles 50 in a single nozzle row 50a - d are in fluid communication to one another via their respective marking material supply channel (58a - d in Fig. 3B). One marking material supply channel 58a - d for each color of the marking materials is provided per multi-color print head 12b - c. Each marking material supply channel 58a - d is connected to a respective marking material supply reservoir or container 70a - d via a respective marking material supply line 17 for supplying the respective color of the marking material to the respective nozzle row 50a - d.

The carriage 13 is further provided with mono-material print heads 12a, 12d. These mono-material print heads 12a, 12d on their own are structurally similar or identical to the multi-color print heads 12b - c. However, all marking material supply channels 58a - d of a single mono-material print heads 12a, 12d are connected to a single marking material supply reservoir 70e - f. All marking material supply lines 17 for a mono-material print head 12a, 12d are connected to the same marking material supply reservoir 70e - f. These specific marking material supply reservoirs 70e - f hold a marking material different from the color markings material in the marking material supply reservoirs 70a - d. The specific marking material supply reservoirs 70e - f may hold a marking material for assisting in the printing of the color marking materials, for example a primer, a varnish, or white ink. The mono-material print heads 12a, 12d are thus configured to jet a single marking material from all or multiple nozzle rows 50a - d in contrast to the multi-color print heads 12b - c which are configured to jet a single marking material from each nozzle row 50a - d. As such a mono-material print head 12a, 12d is capable of depositing a single marking material at multiple times the rate of which a single multi-color print head 12b - c can jet a single type of marking material.

[0028] The carriage 13 is guided by a guide 15 in the form of guide rails or rods 15, as depicted in Fig. 2. The carriage 13 may be driven along the guides 15 by a suitable driving actuator (not shown). In the embodiment of the roll printer 1 shown in Fig. 1 an image is swath-wise printed by moving the print medium 8, 9 over the platen 51, continuously or stepwise between passes of the carriage 13. In another embodiment the apparatus 1 may be a flatbed printer wherein the print medium 8, 9 is stationary on the support surface during printing and the carriage is moved in both the scanning direction B and the non-scanning direction A. In a further embodiment, the printer may comprise a moveable medium support table for moving the medium with respect to the print heads or a rigid substrate feeder, such as a transport belt, for moving the substrates along the print heads.

[0029] Fig. 4 illustrates a method of controlling the print heads 12a-d on the carriage to print an image. The controller 6 receives image data which forms part of print job information submitted by an operator, e.g. via the user interface 5 or the network 7. The controller 6 determines from said print job information whether the application of a further layer S1, S3 is required. The print job information may comprise a predetermined further marking material type setting or parameter which triggers the controller 6 to instruct the further print heads 12a, 12d to deposit a further layer. Additionally, the controller 6 may determine the need for a further layer from other print job information, such as a selected dark or black print medium which benefits from a white ink support layer or a selected marking material type or application that benefits from a varnish coating.

[0030] In case the further marking material type parameter is negative, indicating no further layer S1, S3 is required, the controller 6 operates in a first print mode wherein the controller 6 controls the multi-color print heads 12b - c. An image is then printed, preferably in multi-pass printing, using only the first marking material types. The image in Fig. 4 is formed by 5-pass printing, indicating that the multi-color print heads 12b - c pass five times over each to be printed area of the print medium 8. The multi-color print heads 12b - c defines a first print swath width W2 which extends in the non-scanning direction A. The width of each individual swath S2a - e is approximately one fifth of the first print swath width W2. During each stroke or pass for forming a swath S2a - e a portion or fraction of the final ink coverage is deposited by the multi-color print heads 12b - c in a certain area of the print medium 8, such that when the respective area or portion of the print medium 8 reaches the end of the first print swath width W2 the multi-color image is completed. Each multi-color print head 12b - c is capable of jetting all the colors required for the image layer S2, for example CYMK. Thereto, the nozzle rows 50a - d of each multi-color print head 12b - c are supplied with their respective color marking material type. Only a single print head 12b - c unit is then required for forming a respective portion of each swath S2a - e (in contrast to a single print head unit per color). This results in a very compact carriage construction. Fig. 4 further includes a curing station 80 positioned to cure the deposited ink swaths S2a - e. The curing station 80 is controlled corresponding to the curing requirements for the respective color marking material types as well the print job information to achieve the desired appearance of the color layer in terms of e.g. gamut, gloss, etc. The curing station 80 maybe arranged to cure during passes of the carriage 13, in between individual passes, and/or downstream of the print head units 12a - d. It will be appreciated that any integer number (1, 2, 3...) of passes may be applied for completing the image layer S2.

[0031] In case the further marking material type parameter is positive, the controller 6 operates in a further print mode and instructs the further print heads 12a, 12d to deposited a further layer S1, S3 where required. For example, in Fig. 4 the print medium 8 may be a darkly colored medium, such as black canvas or darkly colored paper. The controller 6 may then determine that a white ink support layer S1 is required as a basis for the color image S2. The controller 6 then determines from the image data support layer data which defines instructions for the white ink print head 12a to deposit a support layer S1, which is to support the image layer S2. The support layer data may comprise geographical information as to the white ink deposition locations and/or the white ink layer thickness or surface properties. The controller 6 operates the white ink print head 12a to deposit a white ink support layer S1. The white ink print head 12a is similar to the multi-color print heads 12b - c with the exception that all its nozzle rows 50a - d are connected to a white ink reservoir 70e. This allows the white ink print head 12a to deposit the white ink at four times the rate at which the multi-color print heads 12b - c may deposit a single color. In consequence, the white ink support layer S1 may be completed in less passes than the color image layer S2. In the example shown in Fig. 4 the white ink support layer S1 may be formed in a single pass. Therein the white ink print head 12a may print for example only the upper half (above the dotted line) of the white ink support layer S1. This provides additional time for drying or curing the white ink support layer S1 before it reaches the first print swath width W1. Alternatively the white ink support layer S2 may be printed in a 2-pass process, wherein a first half of the predetermined total white ink coverage is deposited in a first pass (above the dotted line) while the second half is deposited in a second pass when the respective area has been moved (to below the dotted line). Since the white ink print head 12a is structurally similar to the multi-color print heads 12b - c but less in number and all print head units 12a - d are mounted together on the same carriage 13, the white ink print swath width W1 is less than the first color print swath width W1. To maintain productive printing of the image layer S2 similar to that in the first print mode, the white ink, if required, is jetted at an increased deposition rate, such that the white ink layer S1 may be completed in less passes than the image layer S2 (with respect to the same portion of the print medium 8). The deposition rate may be expressed in any suitable form, for example volume of jetted ink per unit area and unit time, output ink flow per nozzle, ink coverage per unit area and unit time, etc. It will be appreciated that in the above example white ink is used as a specific example. The further print head unit 12a may in another embodiment also be configured for jetting different further marking material types, such as primer, a different color of ink different, or a transparent ink.

[0032] Additionally, the print job may require the image layer S2 to be provided with a suitable coating, such as a varnish. Thereto the controller 6 determines coating layer data to instruct and control the coating print head 12d. In correspondence with the coating layer data the coating print head 12d deposits a coating layer S3 on the image layer S2. The operation of the coating print head 12d may be similar to that of the white ink print head 12a, with the exceptions that the coating print head 12d jets a coating marking material from all its nozzle rows 50a - d and prints on top of the image layer S2.

[0033] Fig. 5A shows a different embodiment, wherein multiple mono-material print heads 12a, 12d are provided upstream of the multi-color print heads 12b - c. The support layer S1 is formed of a white or transparent ink, which is supplied from a support layer ink reservoir 70e. All nozzle rows 50a - d of both support layer print heads 12a, 12d are in fluid communication to said support layer ink reservoir 70e. This allows for an even higher deposition rate as compared to Fig. 4. The embodiment in Fig. 5A is particularly advantageous for applications requiring thicker support layers, for example 2.5D and 3D printing. A three-dimensionally structured support layer S1 may therein be rapidly formed by means the support layer print heads 12a, 12d. After completion said support layer S1 is covered by a color layer S2 to complete the three dimensionally structured color print.

[0034] Fig. 5B illustrates an embodiment particularly suited for the printing of so-called day-night applications. The carriage 13 is provided with a mono-material print head unit 12a in between two multi-color print head units 12b, 12b', when viewed in the scanning direction B. The controller 6 receives a print job with image data, which defines a first and a second color layer S2, S3 separated by an intermediate support layer S1. One or more multi-color print heads 12b, c are positioned on the upstream side of the carriage 13 and controlled in accordance with the first color image data to form a first image layer S2, preferably in a multi-pass process. The print medium 8 in this case is preferably a transparent medium, which allows the printed image to be viewed from the non-printed side. When an area of the first image layer S2 has been completed, it is jetted with a white ink (or another suitable further marking material type) in accordance with the support layer data. The print head arrangement in Fig. 5B allows for the deposition of a portion of the first image layer S2, the deposition of a portion of the intermediate support layer S1 on a printed portion of the first image layer S2, and the deposition of the second image layer S3 on a printed portion of the intermediate support layer S1 (which intermediate support layer S1 itself is supported on a printed portion of the first image layer S2), all in a single pass of the carriage 13 in the scanning direction B.

The support layer S1 is formed such that the combination of the first image layer S2 and the support layer S1 is at least to some degree transparent. On top of the support layer S1, a second color layer S3 is deposited. The image formed by the second color layer S3 is complementary to that of the first image layer S2. The first image layer S2 forms the so-called day-layer, which represents the print as viewed by substantially reflected light only, i.e. as during the day. The second image layer S3 is designed to be visible when the print is provided with an activated backlighting. The second image layer S3 then complements the first image layer S2 by showing features which are only visible when sufficiently backlighting, i.e. during the night.

[0035] Fig. 6 shows a single droplet jetting device 10 which is one of a plurality of jetting devices that have an identical design and are integrated into a common MEMS chip that may be used in an inkjet print head, for example. The MEMS chip and, accordingly, the jetting devices 10 have a layered structure comprising as main layers a distribution layer 12, a membrane layer 14 and a nozzle layer 16.

[0036] The distribution layer 12 is a single silicon layer having a relatively large thickness of at least 200 micron, preferably 300 micron and more preferably more than 400 micron. In the present example, the thickness is 400 micron. The distribution layer 12 defines an marking material supply line 18 through which liquid ink may be supplied from an ink reservoir 19 to a pressure chamber 20 that is formed on the bottom side of the membrane layer 14. The ink reservoir 19 is common to a plurality of jetting devices and is formed separately from the distribution layer 12 on the top side of the distribution layer, i.e. on the side opposite to the membrane layer 14. This has the advantage that the distribution layer 12 is not weakened by any cavity forming the reservoir.

[0037] The membrane layer 14 is obtained from a SOI wafer having an insulator layer 22 and silicon layers 24 and 26 formed on both sides thereof. In this embodiment, the final membrane layer 14 may have a thickness of about 75 micron. The pressure chamber 20 is formed in the bottom silicon layer 26. The top silicon layer 24 and the insulator layer 22 form a continuous flexible membrane 30 with uniform thickness which extends over the entire area of the MEMS chip and is pierced by an opening 28 only at the position of the marking material supply line 18 so as to connect the marking material supply line to the pressure chamber 20. A piezoelectric actuator 32 is formed on the top side of the part of the membrane 30 that covers the pressure chamber 20. The actuator 32 is accommodated in an actuator chamber 34 formed at the bottom side of the distribution layer 12.

[0038] An electrically insulating silicon oxide layer 36 insulates the actuator 32 and its electrodes from the silicon layer 24 and carries electric leads 38 arranged to contact the electrodes on the top and bottom sides of the actuator 32. The leads 38 are exposed and contactable in a contact region 40 where the distribution layer 12 has been removed.

[0039] The nozzle layer 16 is obtained from a double-SOI wafer and has a top silicon layer 42 and a thinner silicon layer 44 interposed between two insulator layers 46 and 48. In this embodiment, the final nozzle layer may have a thickness of about 125 micron. A nozzle 50 is formed in the two insulator layers 46 and 48 and in the silicon layer 44 intervening between them, so that the thickness of these three layers defines the length of the nozzle. The top silicon layer 42 of the nozzle layer 16 defines a feedthrough 52 which connects the pressure chamber 20 to the nozzle 50 but has a cross-section that is significantly larger than that of the nozzle 50.

[0040] It will be understood that the droplet jetting devices 10 of the MEMS chip are arranged such that their nozzles 50 define a nozzle array consisting for example of one, two or even more parallel nozzle lines with uniform nozzle-to-nozzle spacings which will determine the spatial resolution of the print head. Within the contact region 40, each of the leads 38 can be contacted, e.g. via bumps 54, so that energizing signals in the form of electric voltage pulses may be applied individually to each actuator 32. When a voltage is applied to the electrodes of the actuator 32, the piezoelectric material of the actuator is caused to deform in a bending mode, thereby flexing the membrane 30 and consequently changing the volume of the pressure chamber 20. Typically, a voltage pulse is applied to the actuator to cause a deformation that increases the volume of the pressure chamber 20, so that ink is sucked-in from the supply line 18. Then, when the voltage pulse drops off or changes into a pulse with opposite polarity, the volume of the pressure chamber 20 is decreased abruptly, so that an acoustic pressure wave is generated which propagates through the pressure chamber 20 and through the feedthrough 52 to the nozzle 50, with the result that a droplet of ink is jetted-out from the nozzle 50.

[0041] In order to obtain a stable and reproducible droplet generation and jetting behaviour, it is necessary that some critical parameters of the design of the jetting device 10 are controlled with high accuracy. This applies in particular to the length and the cross-sectional area of the nozzle 50 and to the acoustic properties and flow properties of the marking material supply line 18.

[0042] When the actuator 32 performs a suction stroke, ink is sucked in from the marking material supply line 18 whereas capillary forces in the nozzle 50 prevent ambient air from entering through the nozzle. Then, during the subsequent compression stroke of the actuator 32, the acoustic pressure that causes the ink to be jetted out from the nozzle 50 has to overcome the capillary forces in the nozzle as well as the frictional forces that are produced in the nozzle 50 and in the feedthrough 52 due to a certain viscosity of the liquid ink. The marking material supply line 18 must be designed such that, in spite of these resistances, a significant part of the ink is forced out as a droplet through the nozzle 50 rather than being only pushed back into the marking material supply line 18. To that end, the marking material supply line 18 is designed to have a certain inertance, so that the inertia of the liquid that flows-in during the suction stroke will compensate the forces that tend to urge the liquid back in opposite direction during the compression stroke.

[0043] In order to control the inertance of the marking material supply line 18, this supply line forms a restrictor 56, i.e. a liquid flow passage with a certain length L and a certain cross-sectional area A. If ρ is the density of the liquid ink, then the inertance I is given by:

$$I = \rho\ L/A.$$

[0044] Consequently, the inertance could theoretically be made as large as desired by reducing the cross-sectional area A. This, however, would also increase the frictional flow resistance due to the viscosity of the ink, so that, in practise, the cross-sectional area A cannot be reduced below a certain limit. Consequently, the restrictor 56 must necessarily have a certain length L.

[0045] In the design that is proposed here, the relatively large thickness of the distribution layer 12 is utilized for arranging the restrictor 56 to extend vertically through the distribution layer 12. That is, the longitudinal axis of the restrictor 56 is normal to the plane of the layers 12, 14 and 16 of the device. This permits a compact design with small dimensions of the jetting device 10 in the plane of the layers 12 - 16. This has the advantage that a larger number of MEMS chips can be produced from a single wafer having a given diameter. Further, the compact design permits a close packing of the individual devices 10 within the chip, and therewith a high nozzle density and, consequently, a high spatial resolution of the print head. Another advantage of the vertical arrangement of the restrictor 56 is that the length and cross-sectional area of the restrictor can be controlled with high precision by using well-established lithographic techniques.

[0046] In the example shown, the restrictor 56 extends between an marking material supply channel or trench 58 and a restrictor cavity 60, forming an end part of the marking material supply line 18, that have been formed in the top surface and the bottom surface, respectively, of the distribution layer 12. This permits to select the length L of the restrictor 56 independently from the total thickness of the distribution layer 12. Nevertheless, the length L of the restrictor can be controlled with high precision because the total thickness of the distribution layer 12 is known or can be measured with high accuracy, and the respective depths of the marking material supply channel 58 and the restrictor cavity 60 can be determined precisely by controlling the etch times when the trench and/or restrictor cavity are formed by etching.

[0047] As has been shown in Fig. 6, the distribution layer 12 is connected to the membrane layer 14 by a bonding layer 62. Similarly, the membrane layer 14 is connected to the nozzle layer 16 by a bonding layer 64. The bonding layers 62 and 64 being layers of adhesive, their physical properties are difficult to control. However, in the design that has been proposed here, the bonding layers are arranged such that their properties do not significantly affect any of the critical parameters of the design.

[0048] In particular, when a part of the adhesive forming the bonding layer 62 is squeezed out into the restrictor cavity 60, this may affect the width of this restrictor cavity 60, but the reduction in width will be negligible in comparison to the total width of the restrictor cavity 60. Most importantly, the adhesive of the bonding layer 62 will in no way affect the critical cross-sectional area A nor the length L of the restrictor 56, so that the inertance can be controlled with high precision.

[0049] Similarly, any adhesive that may be squeezed out from the bonding layer 64 into the feedthrough 52 will only affect the (less critical) width of the feedthrough but not the cross-sectional area of the nozzle 50.

[0050] As above mentioned, the distribution layer 12 may be 400 microns, while the membrane layer 14 and the nozzle layer 16 together may be only 200 microns thick. Hence, the mechanical strength and rigidity to enable to handle the fabricated wafer stack results from the thickness of the distribution layer 12. Note that the rigidity and mechanical strength are also needed for efficient droplet forming upon bending of the actuator 32. Without sufficient rigidity, the actuator 32 would bend not only the membrane 30, but potentially the whole stack would be deformed, resulting in a significant loss of bending energy and a corresponding deterioration of the actuation efficiency. Further, as the distribution layer provides for mechanical strength and rigidity, the membrane layer and the nozzle layer may have any desirable thickness, thereby providing more freedom of design, potentially resulting in a more efficient fluidic/acoustic design of the print head. Efficiency, in this case, may relate to energy efficiency or cost efficiency or efficiency of dimensions, or any other property that may be optimized.

[0051] 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 are herewith disclosed.

Further, it is contemplated that structural elements may be generated by application of three-dimensional (3D) printing techniques. Therefore, any reference to a structural element is intended to encompass any computer executable instructions that instruct a computer to generate such a structural element by three-dimensional printing techniques or similar computer controlled manufacturing techniques. Furthermore, such a reference to a structural element encompasses a computer readable medium carrying such computer executable instructions. 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. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language). The term coupled, as used herein, is defined as connected, although not necessarily directly.

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 with a scanning inkjet printer (1), the printer (1) comprising a medium support surface (51) and a carriage (13) mounted reciprocally moveable in a scanning direction (B) over the medium support surface (50A), the carriage (13) holding a plurality of separate print head units (12a - d), each print head unit (12a - d) comprising a plurality of nozzle rows (50a - d) extending in a non-scanning direction (A) perpendicular to the scanning direction (B), wherein each nozzle row (50a - d) is in fluid communication to a respective marking material supply reservoir (70a -f) for supplying a predetermined marking material type to said nozzle row (50a - d), the separate print head units (12a - d) extending in the non-scanning direction in a staggered configuration, such that the nozzle rows (50a - d) of adjacent print head units (12a - d) partially overlap with one another when viewed in the scanning direction (B), the method comprising the steps of:

   - supplying different first marking material types with each a different colorant from a plurality of different first marking material supply reservoirs (70a - d) to respective first nozzle rows (50a - d) of the first print head units (12b - c), each first marking material supply reservoir (70a - d) holding a single first marking material type, such that each of said first print head units (12b - c) is allowed to simultaneously jet different first marking material types; and
   - supplying a further marking material type different from the first marking material types from a further marking material supply reservoir (70e - f) separate from the first marking material supply reservoirs (70a - d) to all nozzle rows (50a - d) of a further print head unit (12a, 12d) different from the first print head units (12b - c), such that said further print head (12a, 12d) unit is allowed to jet said further marking material type from all its nozzle rows (50a - d).

2. The method according to claim 1, wherein the further print head unit (12a, 12d) is positioned in the staggered configuration at least partially non-overlapping at least of one of the first print head unit (12b - c), when viewed in the scanning direction (B).

3. The method according to claim 1 or 2, wherein the further print head unit (12a, 12d) is positioned at an end of the staggered configuration of print head units (12a - d) when viewed along the non-scanning direction (A).

4. The method according to any of the previous claims, further comprising the steps of:

   - jetting a first marking material type in a first pass of the carriage (13);
   - jetting the further marking material type with a deposition rate at least twice, thrice, or four times a maximum deposition rate of the first marking material type in the first pass.

5. The method according to any of the previous claims, further comprising the steps of:

   - a controller (6) receiving print job information defining first image data for forming an image layer with the first marking material types and further image data for forming a further layer of the further marking material type, wherein the image layer and the further layer are designated to be printed overlapping one another;
   - the controller controlling the first print head units (12b - c) in correspondence with the first image data to print a portion of the image layer (S2) on an area of the print medium (8, 9) in a predetermined first number of passes of the first print head units (12b - c) over said area;
   - the controller (6) controlling the further print head unit (12a, 12d) in correspondence with the further image data to print a portion of the further layer (S1) on said area of the print medium (8, 9) in a predetermined further number of passes of the further print head unit (12a, 12d) over said area, wherein the further number is less than the first number, preferably no greater than half the first number.

6. The method according to claim 4 or 5, wherein in the first pass the further print head unit (12a, 12d) deposits a swath of the further marking material type adjacent a swath being deposited by first print head units (12b - c).

7. The method according to any of the previous claims, wherein each print head unit (12a - d) comprises a MEMS manufactured print head structure formed of a plurality of stacked substrates processed to comprise a pressure chamber and an actuator chamber for holding an actuator configured to deform to generate a pressure pulse in the pressure chamber, such that a droplet of an marking material type is jetted from a nozzle in a nozzle row, wherein all print head units comprise identical MEMS manufactured print head structures.

8. The method according to any of the previous claims, wherein the further marking material type is a specialty marking material type, such as white ink, varnish, or primer.

9. The method according to claim 8, wherein the first marking material types each comprise a different colorant, such that full color images are formable by a combination of said first marking material types.

10. The method according to any of the previous claims, further comprising the steps of:

- in a first print mode controlling the first print head units (12b - c) to deposit overlapping first swaths formed of the first marking material types to form an image in multiple passes of the carriage (13); and
- in a further print mode controlling the first print head units (12b - c) to deposit overlapping first swaths formed of the first marking material types to form an image in multiple passes of the carriage (13), wherein the further print head unit (12a, 12d) is in each pass controlled to deposit a further swath of the further marking material type parallel to the first swaths, preferably wherein the further swaths of the further marking material type are deposited in for the majority or substantially non-overlapping manner with one another.

11. The method according to any of the previous claims, wherein the further print head unit (12a) is positioned between a pair of the first head units (12b - 12b') when viewed in the scanning direction (B), the method comprising within a single pass of the carriage (13) the steps of:

- a first one (12b, c) of the pair of the first head units (12b - c) printing a first swath (S2) of a first image layer with the first marking material types;
- the further print head unit (12a) printing a further swath (S2) of a further layer with the further marking material type on a portion of the first layer printed by the first one of the pair of the first head units (12b - c); and
- a second one (12b') of the pair of the first head units (12b - d) printing a second swath (S2) of a second image layer with the first marking material types on a portion of the further layer printed by the further print head unit (12a).

12. A scanning inkjet printer (1) comprising a medium support surface (51) and a carriage (13) mounted reciprocally moveable in a scanning direction (B) over the medium support surface (51), the carriage (13) holding a plurality of separate print head units (12a - d), each print head unit (12a - d) comprising a plurality of nozzle rows (50a - d) extending in a non-scanning direction (A) perpendicular to the scanning direction (B), wherein each nozzle row (50a - d) is in fluid communication to a respective marking material supply reservoir (70a - f) for supplying a predetermined marking material type to said nozzle row (50a - d), the separate print head units (12a - d) extending in the non-scanning direction (A) in a staggered configuration, such that the nozzle rows (50a - d) of adjacent print head units (12a - d) partially overlap with one another when viewed in the scanning direction (B), wherein

- nozzle rows (50a - d) of first print head units (12b - c) are respectively in fluid communication to different first marking material supply reservoirs (70a - d), each first marking material supply reservoir (70a - d) configured to hold a single first marking material type, such that each of said number of said first print head units (12b - c) is allowed to simultaneously jet different first marking material types; and
- nozzle rows (50a - d) of a further print head unit (12a, 12d) different from the first print head units (12b - c) are in fluid communication to a further marking material supply reservoir (70e - f) configured to hold a further marking material type, such that said further print head unit (12a, 12d) is allowed to simultaneously jet the further marking material type from all its nozzle rows (50a - d).

13. The scanning inkjet printer (1) according to claim 12, further comprising a controller (6) configured for:

- receiving print job information defining first image data for forming a first image layer with the first marking material types and further image data for forming a further layer with the further marking material type, wherein the image layer and the further layer are designated to be printed overlapping one another;
- controlling the first print head units (12b - c) in correspondence with the first image data to print a portion of the image layer on an area of the print medium in a predetermined first number of

passes of the first print head units over said area; and

- controlling the further print head (12a, 12d) unit in correspondence with the further image data to print a portion of the further layer on said area of the print medium in a predetermined further number of passes of the further print head unit over said area, wherein the further number is less than the first number, preferably no greater than half the first number.

14. The scanning inkjet printer (1) according to claim 12 or 13, wherein each print head unit (12a - d) comprises a MEMS manufactured print head structure formed of a plurality of stacked substrates processed to comprise a pressure chamber and an actuator chamber for holding an actuator configured to deform to generate a pressure pulse in the pressure chamber, such that a droplet of an marking material type is jetted from a nozzle in a nozzle row, wherein all print head units comprise identical MEMS manufactured print head structures.

15. A print head assembly for use in the printer according to any of the claims 12 to 14, comprising a plurality of separate print head units (12a - d), each print head unit (12a - d) comprising a plurality of separate print head units (12a - d), each comprising a plurality of nozzle rows (50a - d) extending in a non-scanning direction (A), wherein each nozzle row (50a - d) is in fluid communication to a respective marking material supply line (17) for supplying a predetermined marking material type to said nozzle row (50a - d), the separate print head units (12a - d) extending in the non-scanning direction (A) in a staggered configuration, such that the nozzle rows (50a - d) of adjacent print head units (12a - d) partially overlap with one another when viewed in the scanning direction (B), wherein

- nozzle rows (50a - d) of first print head units (12b - c) are respectively in fluid communication to different first marking material supply lines (17), each first marking material supply line (17) configured to supply a single first marking material type, such that each of said number of said first print head units (12b - c) is allowed to simultaneously jet different first marking material types; and

- nozzle rows (50a - d) of a further print head unit (12a, 12d) different from the first print head units (12b - c) are in fluid communication to a further marking material supply line (17) configured to supply a further marking material type, such that said further print head unit (12a, 12d) is allowed to simultaneously jet the further marking material type from all its nozzle rows (50a - d).

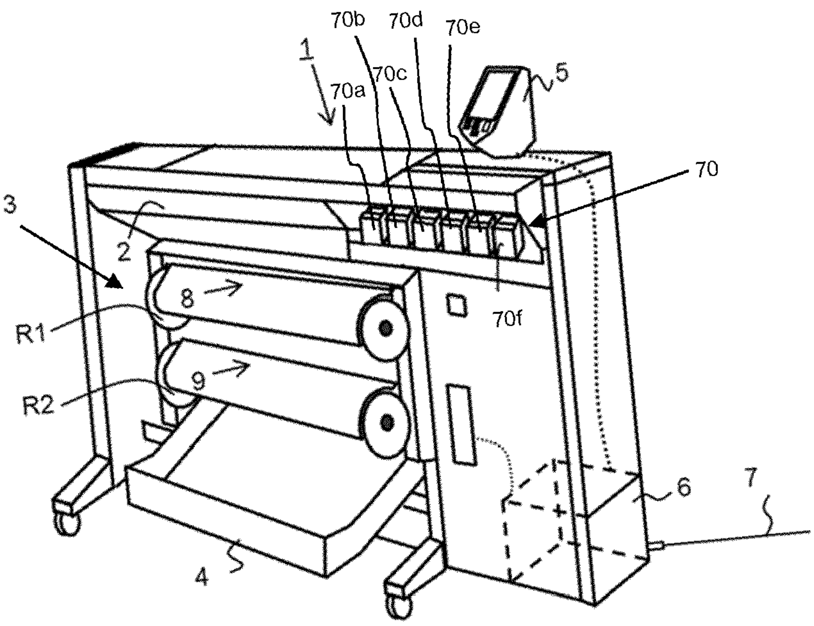

70b
70d
70e
1
70a
70c
5
70
3
2
8
R1
70f
9
R2
6
7
4

Fig. 1

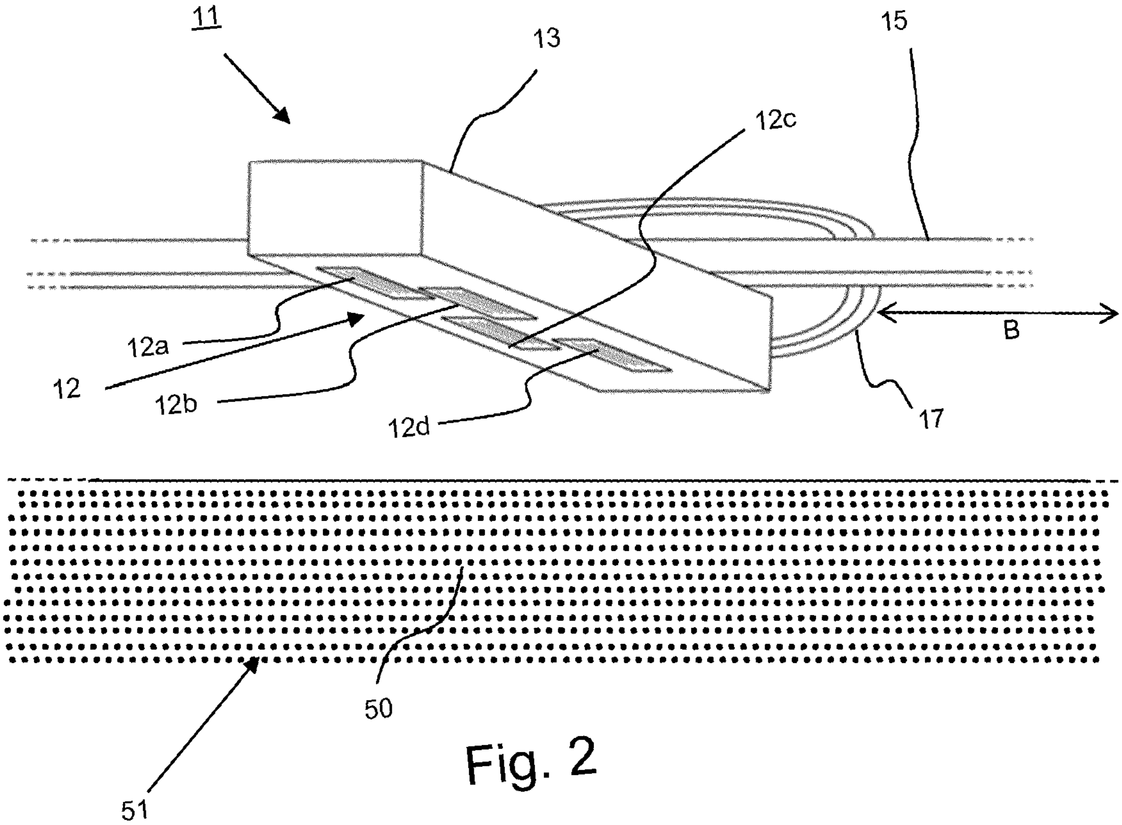

11
13
15
12c
12a
12
12b
12d
B
17
50
51

Fig. 2

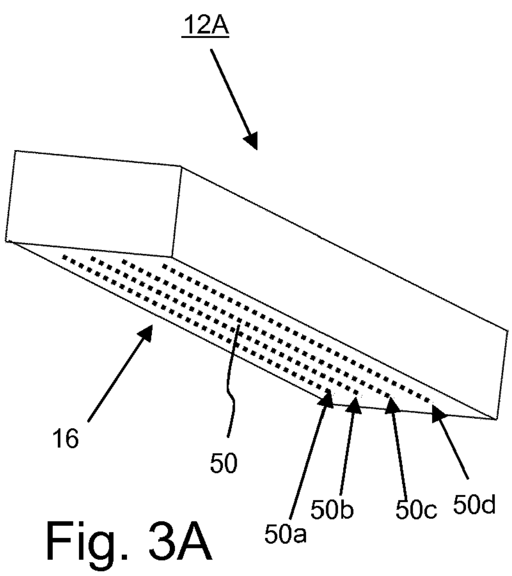


Fig. 3A

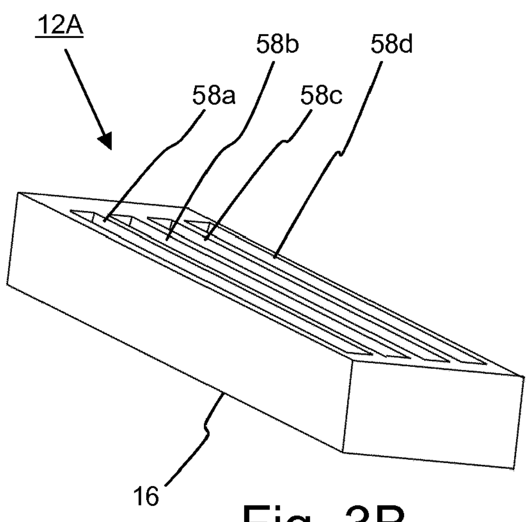


Fig. 3B

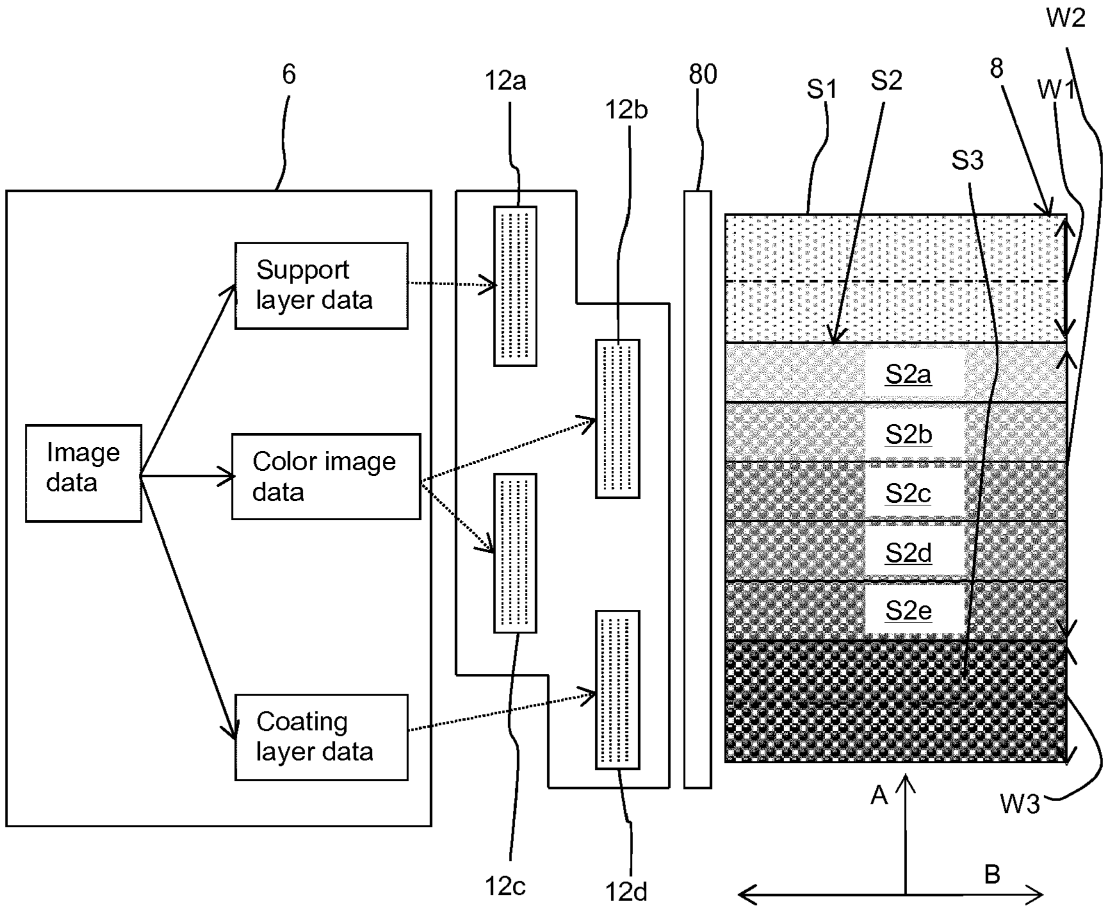


Fig. 4

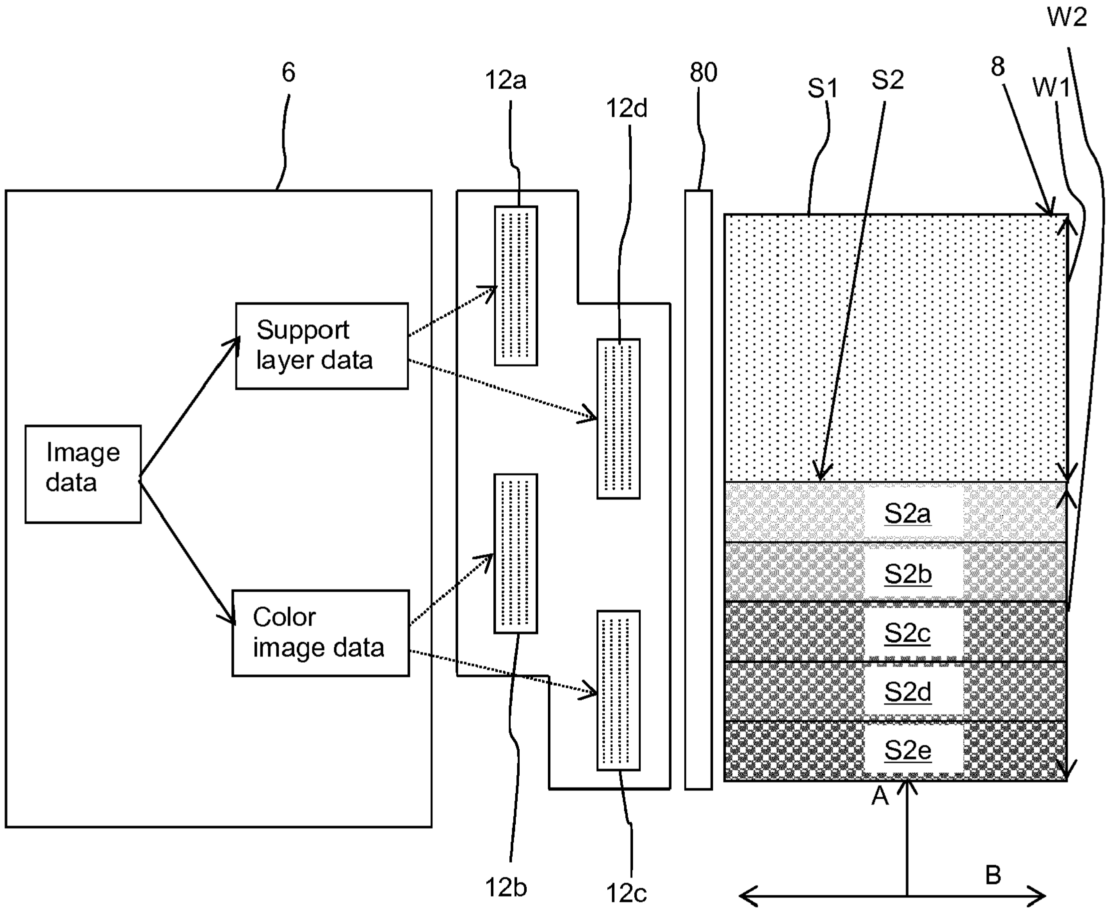

6
12a
12d
80
S1
S2
8
W1
W2
Support layer data
Image data
Color image data
S2a
S2b
S2c
S2d
S2e
A
B
12b
12c

Fig. 5A

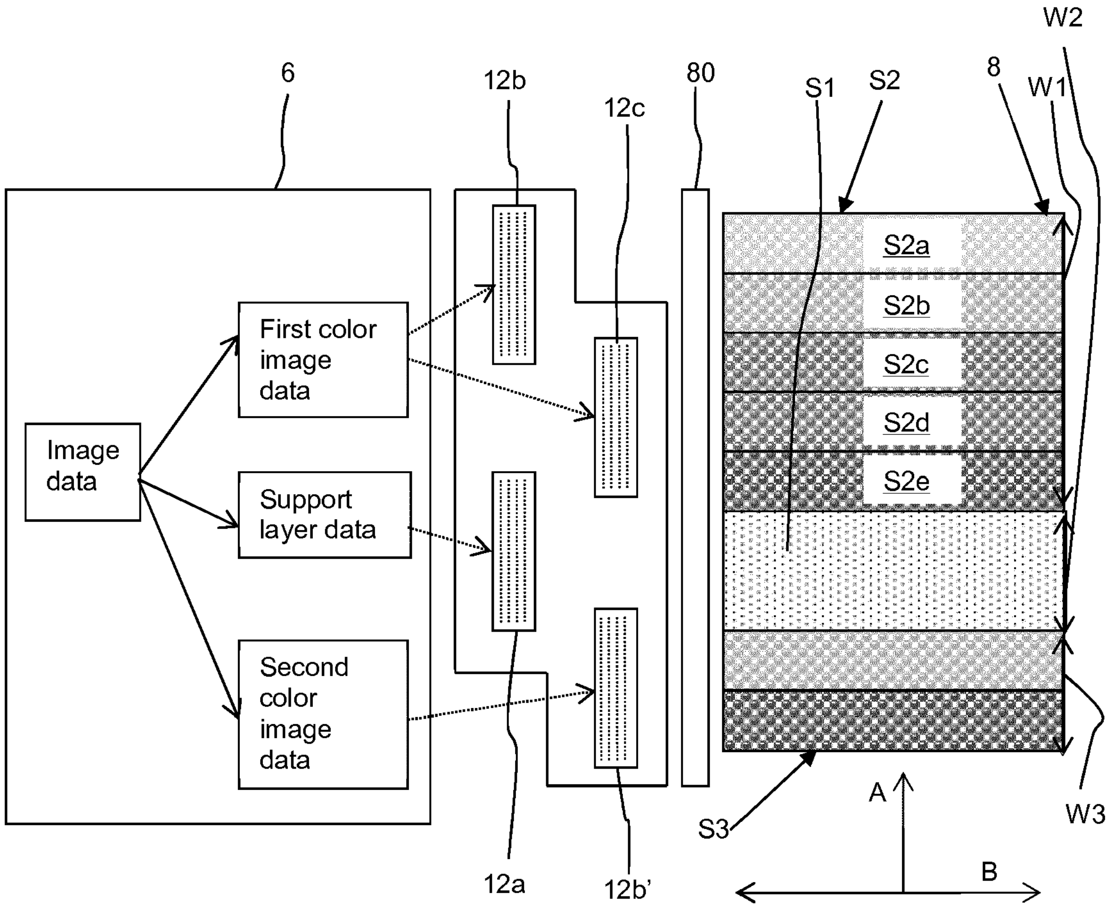
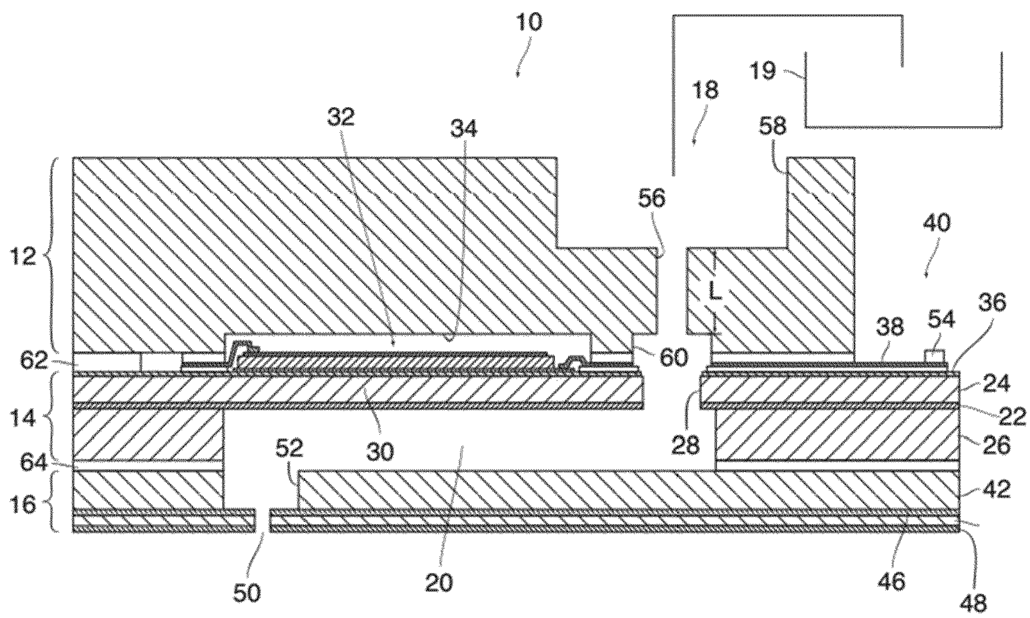

6
12b
12c
80
S1
S2
8
W1
W2
Image data
First color image data
Support layer data
Second color image data
S2a
S2b
S2c
S2d
S2e
S3
A
B
W3
12a
12b'

Fig. 5B


10
19
18
58
32
34
56
40
12
L
38
54
36
62
60
24
14
22
28
26
64
52
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42
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Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 19 20 5169

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B41J

The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	31 March 2020	João, César

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