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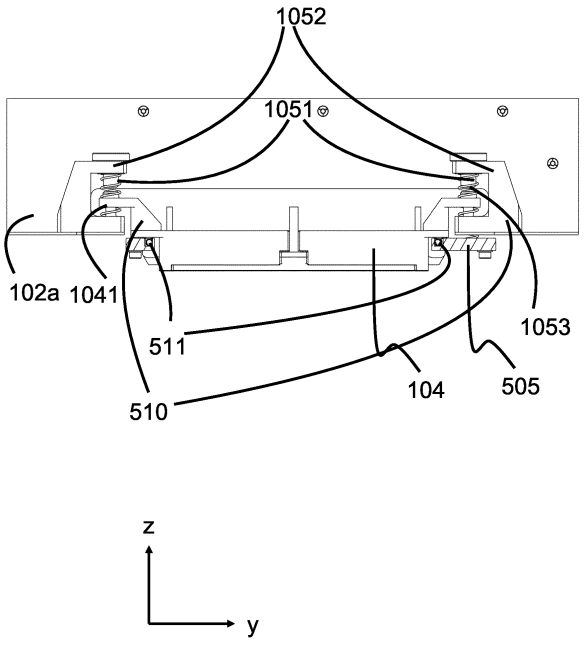
(54) **PRINTER**

(57) A print module (101) for a printer, comprising a material supply unit (103); a printhead (104) in liquid communication with the material supply unit; and a floating printhead holder (105) configured to hold the printhead moveable with six degrees of freedom; wherein at least a lower end portion of the printhead with nozzle openings protrudes through an opening (507) in a surface (501) of the print module in a first direction; and wherein the lower end portion of the printhead comprises a plurality of reference points (512) having a predetermined spatial relationship to the nozzle openings of the printhead.

Fig. 6a



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Description

[0001] The present invention relates to a printer, in particular to a print module and a base plate for a printer and a method for configuring a printer comprising said baseplate and a plurality of print modules.

[0002] In state of the art printers, typically only one printhead is used. However, some modern printers are configured to use a plurality of printheads.

[0003] Problems with referencing said plurality of printheads to each other and/or to remaining elements of the printer may occur and may result in a reduced quality of the print result.

[0004] Furthermore, an exchange of a specific one of said plurality of printheads may be impossible and/or difficult to perform.

[0005] Still further, problems regarding the supply of print material to each individual printhead of the plurality of printheads may occur.

[0006] The above problems are among those solved by the present invention. The invention is set out in the appended set of claims. Any references in the following description to embodiments, objects, aspects and/or examples which are not covered by the appended claims are considered as not being part of the present invention.

[0007] According to an aspect pf the present invention, there is provided a print module for a printer, comprising a material supply unit; a printhead in liquid communication with the material supply unit; and a floating printhead holder configured to hold the printhead moveable with six degrees of freedom; wherein at least a lower end portion of the printhead with nozzle openings protrudes through an opening in a surface of the print module in a first direction; and wherein the lower end portion of the printhead comprises a plurality of reference points having a predetermined spatial relationship to the nozzle openings of the printhead.

[0008] In an embodiment of the invention the printhead comprises two holding portions protruding from the printhead at each end portion in a length direction; wherein the printhead holder comprises two holding mounts configured to receive the respective holding portion of the printhead and configured to confine a movement of the printhead in at least some of the six degrees of freedom, preferably in at least five degrees of freedom.

[0009] In an embodiment of the invention the holding mounts are essentially c-shaped structures with an upper portion, a lower portion, and a connection portion, the latter extending in the first direction; wherein the lower portion of the holding mounts comprises a confinement hole; wherein the holding portions of the printhead comprises guide pins configured to move within the confinement hole.

[0010] In an embodiment of the invention the print module is further comprising spring elements configured to bias the guide pin of a respective holding portion into the confinement hole of the respective holding mount.

[0011] In an embodiment of the invention the print module is further comprising: a plurality of housing guide pins formed to protrude from two opposing surfaces of the print module, which are different from the first surface.

[0012] According to an aspect of the present invention, there is provided a base plate for a print module according to any one of the preceding aspects and embodiments, comprising: a receiving structure configured to receive at least one print module while the print module is inserted into the base plate and configured to secure the print module to the base plate; a referencing base configured to receive the end portion of the printhead and to allow the end portion to pass through the base plate in a z-direction in a state when the print module is inserted into the base plate; wherein the referencing base further comprises a plurality of referencing elements and biasing elements configured:

a) to bias the printhead into a predetermined position and orientation while the print module is inserted into the base plate; and

b) to restrict the movement of the printhead in all six degrees of freedom in a state when the print module is secured to the base plate.

[0013] In an embodiment of the invention the referencing base comprises three upward protruding first reference elements configured to contact the protruding end portion of the printhead and to limit the movement of the printhead to a movement in a plane essentially perpendicular to the z-direction in a state when the print module is inserted into the base plate.

[0014] In an embodiment of the invention the referencing base further comprises at least one second reference element and corresponding biasing means configured to limit the movement of the printhead to a translation in one direction of the plane, preferably a y-direction corresponding to the length direction of the printhead, in a state when the print module is inserted into the base plate.

[0015] In an embodiment of the invention the referencing base further comprises one third reference element and one corresponding biasing means to limit the movement of the printhead into the predetermined position in a state when the print module is inserted into the base plate.

[0016] According to an aspect of the present invention, there is provided a printer comprising a base plate according to any one of the preceding aspects and embodiments and one or more print modules for a printer according to any one of the preceding aspects and embodiments.

[0017] According to an aspect of the present invention, there is provided a method for configuring a printer according to claim 10; comprising the steps of positioning one or more print modules for a printer according to any one of the preceding aspects and embodiments in the base plate; and wherein the third reference elements are configured such that the nozzle openings of adjacent

printheads are aligned.

[0018] According to an aspect of the present invention, there is provided a method for configuring a printer according to the preceding aspect; further comprising the steps of positioning at least two print modules according to any one of claims of the preceding aspects and embodiments in the base plate; wherein the third reference elements are configured such that adjacent printheads are positioned with a predetermined offset in the y-direction.

[0019] It is a first general concept of the invention that a print module with a printhead is provided. The print module is configured for a simple removal of the module from a printing system of a printer.

[0020] It is a second general concept of the invention that the printhead and other electrical components present in the print module are controlled via connecting PCB units connected to an external controller unit, preferably via a central hub controller, for driving said print modules.

[0021] In detail, the print module may comprise one or more of: a high voltage power supply board, a waveform generating board, a control board, and a connecting board. The control board may comprise a local controller unit that allows for a control of a signaling that may be passed on to the waveform generating board, the high voltage board, and/or the external controller unit via the connecting board.

[0022] It is a third general concept of the invention that the printhead is fixed within the print module via a floating printhead holder. The floating printhead holder allows for a constant downward pressure being exerted in a connected state and further allows for adjustments in a length, width and heigh direction with respect to a referencing base. Said adjustment capabilities are preferably obtained via one or more shaped hole and/or recess structures.

[0023] As will be detailed below said hole and recess structure allow for the printhead to be seated in a predetermined position with respect to a reference point in the printer and in case of a plurality of printheads, said plurality of printheads each being comprised within a respective print module, allows for a precise referencing of a relative length and width direction of the printheads.

[0024] It is a fourth general concept of the invention that the printing of multiple materials in different printing modes is obtained with embodiments of a modular printing system of the present invention. This may result in an optimization of multi-material or single material printing.

[0025] A modular printing system may comprise one or more print modules provided on a reference system. The reference system has a referencing base for receiving the print module, and a floating element for providing a spatial reference for a printing head in the printing module.

[0026] In the floating printhead holder the printhead is at least movable linearly in the length, the width and the height direction and is at least rotationally movable around an axis parallel to the length direction, the height direction and the width direction. Said freedom of motion allows for a referencing via a datum system comprised in the base plate in order to align one or more printheads with respect to a reference system, preferably one or more reference points, in the printer.

[0027] The reference point may be a motion system. Said motion system may be configured to provide a movement of the base plate in a linear or rotating fashion via a motorized system such as a linear motion table, robotic arm and/or any other suitable system. Wherein the motion of the base plate in relation to a stationary substrate may be facilitated. Alternatively, a stationary baseplate may be used and the substrate may be moved via a motion system.

[0028] It is a fifth general concept of the invention that in a linear motion printing application a printing method may be utilized that facilitates the printing of one or more materials at the same time through the use of a plurality of printheads each provided in a plurality of print modules that are positioned with a predetermined precise offset to each other in one direction, preferably the y-direction. Alternatively, the multiple printheads may be aligned such that their respective ejection orifices are in complete alignment along the axis of motion of the motion system in a lengthwise direction with respect to the length of the printing module.

Brief description of the Drawings

[0029] In the drawings:

- Fig. 1 shows a print module for a printer according to an embodiment of the invention;
- Fig. 2 shows the print module for a printer in a base plate according to an embodiment of the invention;
- Fig. 3 shows a separating wall of the base plate according to an embodiment of the invention;
- Fig. 4 shows a bottom view of the base plate according to an embodiment of the invention;
- Fig. 5 shows a perspective view of a floating printhead holder in the print module for a printer according to an embodiment of the invention;
- Fig. 6a shows a side view of a floating printhead holder in the print module for a printer according to an embodiment of the invention;
- Fig. 6b shows cross-sectional view of a portion of the floating printhead holder according to an embodiment of the invention;
- Fig. 7 shows a schematic bottom view of the referencing plate according to an embodiment to the invention;
- Fig. 8 shows a schematic bottom view of the referencing plate in a staggered mode according to an embodiment to the invention; and
- Fig. 9 shows a schematic bottom view of the referencing plate in a staggered mode according

to an alternative embodiment to the invention.

Detailed description of the Drawings

[0030] In the following, embodiments of the present invention will be described. It is noted that some aspects of every described embodiment may also be found in some other embodiments, unless otherwise stated or being obvious to the skilled person. However, for increased intelligibility, each aspect will only be described in detail when first mentioned and any repeated description of the same aspect will be omitted.

[0031] In embodiments of the present invention a printer is configured to comprise a plurality of printheads. Each of said printheads is comprised in a print module. Each print module is configured to be positioned in a base plate of the printer. The base plate is configured to receive a plurality of print modules. Each print module is received in a defined position such that all printheads are arranged with a predetermined spatial relationship to each other. In particular, said printheads are arranged such that their respective nozzle openings are aligned with respect to each other and/or the printer.

[0032] When referring to directions in this disclosure, the following definitions of directions apply. The backplate of a material management system generally extends in the upward direction from the relative position of a printhead. The printhead ejects material in a downward direction. A larger dimension of the printhead is in a length direction and a smaller dimension is in a width direction. Wherein the length and width define a plane orthogonal to the upward downward direction. With respect to the motion system of the printer, said length direction of the printhead corresponds to a y-direction; said width direction to an x-direction; and the ejection direction to a z-direction, wherein the material is ejected downward in the z-direction.

[0033] It is noted, that said directions are merely defined in order to improve intelligibility of this description, any other coordinate system suitable for describing a 3D space can be used to identify directions and/or dimensions, in particular in the enclosed drawings.

[0034] Fig. 1 shows a print module for a printer according to an embodiment of the present invention. The print module 101 comprises housing 102, preferably a modular housing structure 102.

[0035] The print module 101 further comprises one or more housing guide pins 106, 107, preferably two first housing guide pins 106 and two second housing guide pins 107. The guide pins are provided on opposing surfaces of the housing, preferably on a front and back surface of the housing 102.

[0036] The print module further comprises a floating printhead holder 105 and a printhead 104 held in the floating printhead holder 105. The print module further optionally comprises an electrical connector 109, a cartridge 103, and a latching portion 108.

[0037] In an embodiment of the invention, the print module comprises or partly comprises a material management system in the module housing 102. The material management system may comprise one or more of: said cartridge, a needle connector, fluid connectors, tubing, a backplate, reducing connectors, t-connectors, a holding tank, a degassing chamber, a heating chamber, heating tubing, heating elements, electrical connectors, a control unit, pumps, separation membranes, valves, dampening units, a bypass structure, a cycling portion, temperature sensors, humidity sensors, and pressure sensors.

[0038] Fig. 2 shows a print module for a printer in a base plate according to an embodiment of the present invention. The base plate 500 comprises a bottom portion 501 and a plurality of separating walls 503 protruding upward from said bottom portion 501.

[0039] Two neighboring separating walls 503 define a space for the print module 101 to be inserted. In other words, the print module 101 may be inserted into the base plate 500 between two separating walls 503 via a guided motion. The guided motion is preferably facilitated by the housing guide pins 106, 107 (not visible in Fig. 2) and two respective guiding slots 502 comprised on each of the two separating walls 503 defining the space for the print module.

[0040] It is noted that the base plate 500 may be configured to receive a plurality of print modules 101. That is, the base plate may comprise a plurality of separating walls corresponding to the plurality of print modules, as shown in Fig. 2.

[0041] Fig. 3 shows a separating wall 503 of a base plate according to an embodiment of the invention. Each separating wall 503 is configured to be provided on the base plate 500 such that it protrudes in an upward direction from the bottom portion or base 501.

[0042] Hereinafter the print module and the base plate are described in three different states or phases:

a) the base plate and the print module are not connected;
b) the print module is inserted into the base plate; and
c) after the print module has been inserted the print module is in a secured state in the base plate.

[0043] The separating wall 503 is configured to guide an insertion of a print module 101 into the base plate 500. In detail, two separating walls 503 define a space for the print module to be received therein. In order to guide the insertion, the separating wall 503 comprises, on at least one of the surfaces defining said space, a guide structure.

[0044] The guide structure preferably comprises one or more guide funnels 502a, configured to receive and guide one or more of the guide pins formed on the housing 102 of the print module. The guide structure further comprises one or more of guides 502b, for guiding the guide pins form the guide funnel 502a to a locking portion 502c, the latter is configured to trap the guide pin and lock the print module 101 in an end position on the base plate.

[0045] It is noted that the end position is preferably a position that allows the lowest portion of the printhead to protrude downwards from the bottom of the base plate and thereby allows material to be ejected to a substrate provided underneath the base plate.

[0046] During the course of said ejection said substrate may be moved in a cartesian motion system, whereas the main scanning direction of the relative motion between the base plate and the motion system is along a width direction of the print module, said direction also referred to as the x-direction.

[0047] A secondary scanning direction is along the lengthwise direction with respect to the length of the print module and is also referred to as the y-direction. A third direction of relative motion of the substrate and the reference base in along a height direction with respect to the printhead module and is also referred to as the z-direction.

[0048] In an alternative embodiment of the invention, the scanning motion can also be performed by the base plate containing one or more of the print modules. The motion may be provided by a linear motion system, robotic motion systems, or rotary motion systems, as discussed above.

[0049] Fig. 4 shows a bottom view of the base plate according to an embodiment of the invention. In detail, Fig. 4 shows the bottom portion or base 501 of the base plate 500 with a referencing base 505 comprised therein. The figure further shows a printhead 104 protruding through the referencing base 505 at the position of a print module (not visible), which is locked at the end position.

[0050] In the not connected state, the printhead is biased in the printhead holder into a locked position, in which the movement of the printhead is limited essentially to an up and down movement.

[0051] However, it is noted that in an alternative embodiment the printhead may also be slightly rotationally free in the disconnected state, when there are no pins referencing against the referencing surfaces.

[0052] In the insertion phase, the printhead is moved upwards against the z-bias within the print module. In this state, the printhead has six degrees of freedom in a range confined by the printhead holder and thus can be guided into a datum position also referred to as the predetermined position.

[0053] In a secured state, i.e., the end position of the print module, the printhead is biased in the predetermined position.

[0054] As detailed above, the floating printhead holder 105 allows the printhead to have a sufficient range of motion in order to be located in a predetermined, i.e., referenced position, within a respective opening 507 provided in the referencing base 505.

[0055] In an embodiment of the invention, a nozzle plate of the printhead is precisely aligned with reference to the printhead surfaces, thus referencing the printhead in the referencing base 505 is equivalent to aligning the nozzle openings with reference to the referencing base.

[0056] In an embodiment of the invention, a contact between the protruding end portion of the printhead and the referencing plate 505 is ensured by the use of spring loaded pins, which push against surfaces of the printhead, which are opposing the respective referencing surface of the printhead and thus bias the printhead against referencing surfaces of the referencing base 505.

[0057] In a preferred embodiment of the invention, the referencing plate 505 is made from metal, preferably a nickel alloy, and more preferably from one or more of: Inovco, Kovar, Invar, Dilvar P, Inconel, Alloy 42 or any other alloy with a sufficiently low, Coefficient of Thermal Expansion, CTE for a precise alignment of the printheads.

[0058] Fig. 5 shows a perspective view of a floating printhead holder in the print module for a printer according to an embodiment of the invention; Fig. 6a shows a side view of a floating printhead holder in the print module for a printer according to an embodiment of the invention; and Fig. 6b shows a cross-sectional view of a portion of the floating printhead holder according to an embodiment of the invention.

[0059] As discussed above, the floating printhead holder is configured to hold the printhead in a not connected sate, during insertion of the print module, and in an end position.

[0060] In an embodiment of the invention, the printhead holder 105 comprises two guiding means 1051 each respectively provided in amount 1052. The guiding means 1051 is preferably a guide rod 1054 protruding downward from the mount. Optionally, the guide rod 1054 is provided in form of a screw in an element of the upper portion 1055.

[0061] In an embodiment of the invention, the mount 1052 is essentially c-shaped with essentially flat upper portion 1055; an essentially flat lower portion 1056; and a connection portion 1057, wherein the mount is configured to receive the protruding holding portions 1041 of the printhead therebetween.

[0062] In an embodiment of the invention, the holding portion 1041 comprises an upper extension 1041a configured to protrude upwards into the direction of the guide rod 1053, which protrudes downward from the upper mount portion 1055.

[0063] In an embodiment of the invention, the holding portion 1041 further comprises a lower extension 1041b configured to protrude downward from the holding portion 1041.

[0064] In an embodiment of the invention, the lower portion 1056 of the mount comprises a confinement hole. The confinement hole is configured to confine the motion of the printhead during the insertion. Furthermore, the confinement hole is configured to confine the motion of the printhead in the not connected state essentially to an up and down motion. The motion of the printhead is preferably confined via a confinement of the lower extension 1041b in the lower mount portion 1056.

[0065] In an embodiment of the invention, the lower mount portion 1056 comprises a shaped confinement hole. In detail, the shape confinement hole comprises a funnel section 1056a and a tube section 1056b.

[0066] In a preferred embodiment of the invention, the funnel section 1056a is configured such that the lower extension may move within the funnel section and is generally guided by the funnel to the tube section.

[0067] In a preferred embodiment of the invention, the tube section 1056b is configured such that the lower extension 1041a may essentially only move up and down within the tube section.

[0068] In an embodiment of the invention, a spring element 1053 is provided between the upper portion 1055 of the mount 105 and the holding portion 1041 of the printhead to generate a downward directed spring bias on the printhead. Preferably, the spring element 1053 is provided to surround the guide rod 1054 and the upper extension 1041a.

[0069] In the not connected state the printhead is biased against the lower portion 1056 of the mount 105. That is, the lower extension 1041b is inserted into the tube portion 1056b and the movement of the printhead is confined accordingly.

[0070] When the print module is inserted into the base plate, as discussed above, the printhead is biased against the base 505 and thus moved up. That is, the lower portion 1041b is positioned in the funnel portion 1056a and is confined accordingly.

[0071] In an embodiment of the invention, the printhead 104 comprises two protruding holding portions 1041 corresponding to the respective mounts 1052 of the printhead holder 105. The mounts and holding portions are located in a length direction of the printhead. The protruding portions 1041 are preferably protruding from an upper surface of the printhead 104 up and protrude further out in a length direction in order to protrude into the corresponding mount 1052.

[0072] In other words, the confinement in the floating holder 105 allows for multiple axes of motion while ensuring that an elastic downward pressure is be applied from the spring element. The printhead thereby has limited linear freedom of motion along the x-, y- and z-axis and a limited range of rotational motion perpendicular to all planes defined by any combination of the three aforementioned axes.

[0073] Said range of motion allows for the printhead to be controllably referenced within the referencing base of the base plate. As will be detailed below, the referencing base 505 comprises spring loaded pins 511 for biasing the printhead into a predetermined position, when the referencing base is in contact with the z-directional referencing points provided on the underside of the printhead.

[0074] Now turning to Fig. 6a, the bias in z-direction as discussed above is applied. When the print module is inserted into the base plate 500, the printhead is located in the opening 507 of the referencing base 505.

[0075] That is, the printhead 104 is guided by the lower portion 1041b in the funnel portion 1056a and biased in z direction by the spring element 1053 against one or more reference points and/or a reference surface of the referencing base 505. The one or more reference points and/or the reference surface are preferably located at an upper surface of the referencing plate 505.

[0076] In other words, the lower extension 1041b pin is smaller in diameter than the smallest portion of the shaped confinement hole. The shaped confinement hole further allows an increased range of motion, when the printhead and thereby the lower extension 1041b are not in a fully depressed position, thereby allowing for the lower end of the lower extension 1041b to be referenced by an increased diameter cone section of the shaped confinement hole, also allowing an increased rotational motion along the planes defined by any of the pairs of the x-,y-,z- directions.

[0077] Fig. 7 shows a schematic bottom view of the referencing plate according to an embodiment of the invention. In detail, Fig. 7 shows a schematic view of the underside of the referencing plate 505 with three printheads 104 being referenced within the referencing plate 505.

[0078] For referencing the printhead 104 in the reference plate 505 the reference plate comprises one or more biasing means and/or reference elements for each of the directions of freedom. Preferably, the referencing plate 505 comprises spring loaded pins 511 for biasing the printhead against corresponding reference points on the reference plate 505.

[0079] In an embodiment of the invention, the printhead further comprises preferably three z-directional referencing points 512, each respectively provided on the underside of the downward facing printhead surface 513, which are contacting the upper side of the referencing plate 505 with respect to the z-direction. Alternatively, the referencing points 512 may be provided on the upper side of the referencing plate 505.

[0080] The bias in z direction from the spring element of the printhead against the three referencing points 512 limits the movement of the printhead to a movement in a plane defined by the three reference points, preferably the plane is the y-x plane of the base plate.

[0081] In preferred embodiment of the invention, the referencing base 505 further comprises two spring loaded biasing pins 511a for biasing the printhead in x-direction against a corresponding reference element of the referencing base 505, preferably, against reference surfaces located opposed to the biasing pins 511a.

[0082] In other words, the printhead is biased from the biasing pins 511a in x direction against a reference edge of the referencing base 505. Thereby, the movement is limited to an y movement only.

[0083] In preferred embodiment of the invention, the referencing base 505 further comprises one spring loaded biasing pin 511b for biasing the printhead in y-direction, preferably against a referencing edge of point

of the referencing plate 505. Thereby, the movement is stopped in the predetermined position.

[0084] In Fig. 7 the printheads are arranged in a normal printing mode. That is, in the normal printing mode the printheads are arranged such that they are parallel with respect to the x-direction and the nozzle openings of each printhead are essentially at the same positions with respect to the y-direction. Thus, the ejected liquid material droplets form printed lines 601 along the x-axis for an ejection performed during a relative linear translation of a substrate with respect to the printheads.

[0085] Said printed lines from each of the printhead overlap in this normal printing mode. The advantages of the normal printing mode are:

a) In case all printheads are configured to print the same material, more material can be deposited in one translation.

b) In case the printheads are configured to print different materials, within the same line different materials can be deposited during one translation.

[0086] Furthermore, any material that is printed out of a different set of materials to be deposited at a specific position on the substate may be deposited there within a short time period and other materials deposited in the same line are experiencing a similar degree of influencing factors that are commonly experienced by the material after the deposition of liquid materials.

[0087] Said time dependent factors may include material flow, material pinning, curing, or drying. In certain material configurations, especially when printing with many different materials, the reduction of a time difference of similar or dissimilar deposited materials in so called multi-pass printing modes may be preferable as it may increase the controllability of factors such as degree of cure, physical properties and surface or interface properties, as well as the precision of surface geometries.

[0088] Fig. 8 shows a schematic bottom view of the referencing plate in a staggered mode according to an embodiment of the invention. The staggered mode differs from the normal mode in that one or more printheads are referenced to be offset in y direction, preferably by a predetermined offset, which is less that the distance between two nozzle openings.

[0089] Figure 8 shows a schematic view of the printhead configuration in staggered mode from the same perspective as Fig. 7 in normal mode. As detailed above, the printheads have a respective offset along the y-direction, which causes the printed lines to be ejected onto the moving substrate in an offset pattern 601b.

[0090] The staggered mode is thereby increasing the number of lines ejected during one single printing translation. This mode has the advantage that the same liquid materials may be grouped in two or more printheads and thereby multiple sets of non-overlapping lines may be ejected during one translation, thereby covering more area.

[0091] The print speed can effectively be multiplied, depending on how many multiples of a singular material may be ejected from multiple staggered printheads. This configuration may still use only different materials provided in the printheads, but it will loose the advantage of an accelerated printing.

[0092] Furthermore, some of the droplets required to be deposited in the same line may only be deposited after a longer amount of time compared to the normal mode of printing.

[0093] The staggered mode may be obtained via a modification of the referencing base.

[0094] In one embodiment of the invention, different referencing bases 505 are provided for the normal and staggered mode configuration. The referencing bases are configured to be exchanged in the base plate in order to accommodate the different modes of printing in a provided printing system.

[0095] Fig. 9 shows an alternative embodiment of the invention, in which y-adjusting pins and directional referencing surfaces may be provided in both directions of the referencing base.

[0096] In detail, the referencing base comprises two sets of referencing elements, one set of the normal mode and one set for the staggered mode. For illustration, the normal mode referencing elements 513 are illustrated in solid lines and the staggered mode reference elements 515 are illustrated in dashed lines.

[0097] When the y bias is applied via the pins 511 from the lower y direction the printhead is biased against the upper y direction reference edge 513. All upper reference edges are at the same y position. Thus, all printheads are arranged to be in the same predetermined y position. That is, the printheads are arranged in normal mode.

[0098] When the y bias is applied via the pins 514 from the upper y direction the printhead is biased against the lower y direction reference edge 515. All lower reference edges have a predetermined offset 516 in the y direction. Thus, all printheads are arranged to have said predetermined offset 516 in y direction. That is, the printheads are arranged in staggered mode.

[0099] The upper and lower y position of the respective reference edges for normal mode and staggered mode are only for intelligibility of Fig. 9 and not limiting to the subject-matter.

[0100] In other words, in an embodiment of the invention, the printhead and a y biasing pin may be manually or electronically adjusted to be engaged along one of the provided directions, wherein one side of the referencing surfaces or edges is arranged to provide an equal position of all printheads with respect to the y-direction, thereby enabling the normal printing mode and whereby the other side of the referencing surfaces of the main referencing plate are configured to cause a varying printhead displacement along the y direction to align the printheads in the staggered printing mode.

[0101] In detail, the non-engaged pins 514 are not

protruding past the referencing surface present on the referencing base in which they are positioned, to allow a referencing surface present on the printhead to be in full contact with the referencing surface present on the referencing base, in normal mode. In Fig. 9, the printheads are shown in a normal mode configuration, wherein the set of the y-directional referencing pins on the equally referenced side of the referencing base are not engaged.

[0102] What has been described and illustrated hereinabove are embodiments of the invention along with some of variations. The terms, descriptions and figures used herein are set forth by way of illustration only and are not meant as limitations. Those skilled in the art will recognize that many variations are possible within the spirit and scope of the invention, which is intended to be defined by the following claims -and their equivalents- in which all terms are meant in their broadest reasonable sense unless otherwise indicated.

Reference numeral listing

[0103]

101 printing module
102 housing
103 cartridge
104 printhead
1041 holding portion
1041a upper extension
1041b lower extension
105 floating printhead holder
1051 guiding means
1052 mount
1053 spring element
1054 guide rod
1055 upper portion
1056 lower portion
1056a funnel portion
1056b tube portion
1057 connecting portion
106 first housing guide pin
107 second housing guide pin
108 latching point
500 base plate
501 base
502 guide slot
502a guide funnel
502b guides
502c locking portion
503 separating wall
511 biasing pin
511a x direction biasing pin
512 reference point
511b y direction biasing pin
513 normal mode reference edge
514 staggered mode bias pin
515 staggered mode reference edge
516 predetermined offset
601 printed lines
601b printed staggered lines

Claims

1. A print module for a printer, comprising

a material supply unit;
a printhead in liquid communication with the material supply unit; and
a floating printhead holder configured to hold the printhead moveable with six degrees of freedom; wherein at least a lower end portion of the printhead with nozzle openings protrudes through an opening in a surface of the print module in a first direction;
and wherein the lower end portion of the printhead comprises a plurality of reference points having a predetermined spatial relationship to the nozzle openings of the printhead.

2. Print module for a printer according to claim 1,

wherein the printhead comprises two holding portions protruding from the printhead at each end portion in a length direction;
wherein the printhead holder comprises two holding mounts configured to receive the respective holding portion of the printhead and configured to confine a movement of the printhead in at least some of the six degrees of freedom, preferably in at least five degrees of freedom.

3. Print module for a printer according to claim 2,

wherein the holding mounts are essentially c-shaped structures with an upper portion, a lower portion, and a connection portion, the latter extending in the first direction;
wherein the lower portion of the holding mounts comprises a confinement hole;
wherein the holding portions of the printhead comprises guide pins configured to move within the confinement hole.

4. Print module for a printer according to claim 2, further comprising spring elements configured to bias the guide pin of a respective holding portion into the confinement hole of the respective holding mount.

5. Print module for a printer according to any one of claims 1 to 4, further comprising:
a plurality of housing guide pins formed to protrude from two opposing surfaces of the print module, which are different from the first surface.

6. A base plate for a print module according to any one of claims 1 to 5, comprising:

a receiving structure configured to receive at least one print module while the print module is inserted into the base plate and configured to secure the print module to the base plate;
a referencing base configured to receive the end portion of the printhead and to allow the end portion to pass through the base plate in a z-direction in a state when the print module is inserted into the base plate;
wherein the referencing base further comprises a plurality of referencing elements and biasing elements configured:

a) to bias the printhead into a predetermined position and orientation while the print module is inserted into the base plate; and
b) to restrict the movement of the printhead in all six degrees of freedom in a state when the print module is secured to the base plate.

7. Base plate for a print module according to claim 6, wherein the referencing base comprises three upward protruding first reference elements configured to contact the protruding end portion of the printhead and to limit the movement of the printhead to a movement in a plane essentially perpendicular to the z-direction in a state when the print module is inserted into the base plate.

8. Base plate for a print module according to claim 7, wherein the referencing base further comprises at least one second reference element and corresponding biasing means configured to limit the movement of the printhead to a translation in one direction of the plane, preferably a y-direction corresponding to the length direction of the printhead, in a state when the print module is inserted into the base plate.

9. Base plate for a print module according to claim 8, wherein the referencing base further comprises one third reference element and one corresponding biasing means to limit the movement of the printhead into the predetermined position in a state when the print module is inserted into the base plate.

10. A printer comprising a base plate according to any one of claims 6 to 9 and one or more print modules for a printer according to any one of claims 1 to 5.

11. A method for configuring a printer according to claim 10; comprising the steps of

positioning one or more print modules for a printer according to any one of claims 1 to 5 in the base plate; and
wherein the third reference elements are configured such that the nozzle openings of adjacent printheads are aligned.

12. A method for configuring a printer according to claim 10; further comprising the steps of

positioning at least two print modules according to any one of claims 1 to 7 in the base plate;
wherein the third reference elements are configured such that adjacent printheads are positioned with a predetermined offset in the y-direction.

Fig. 1

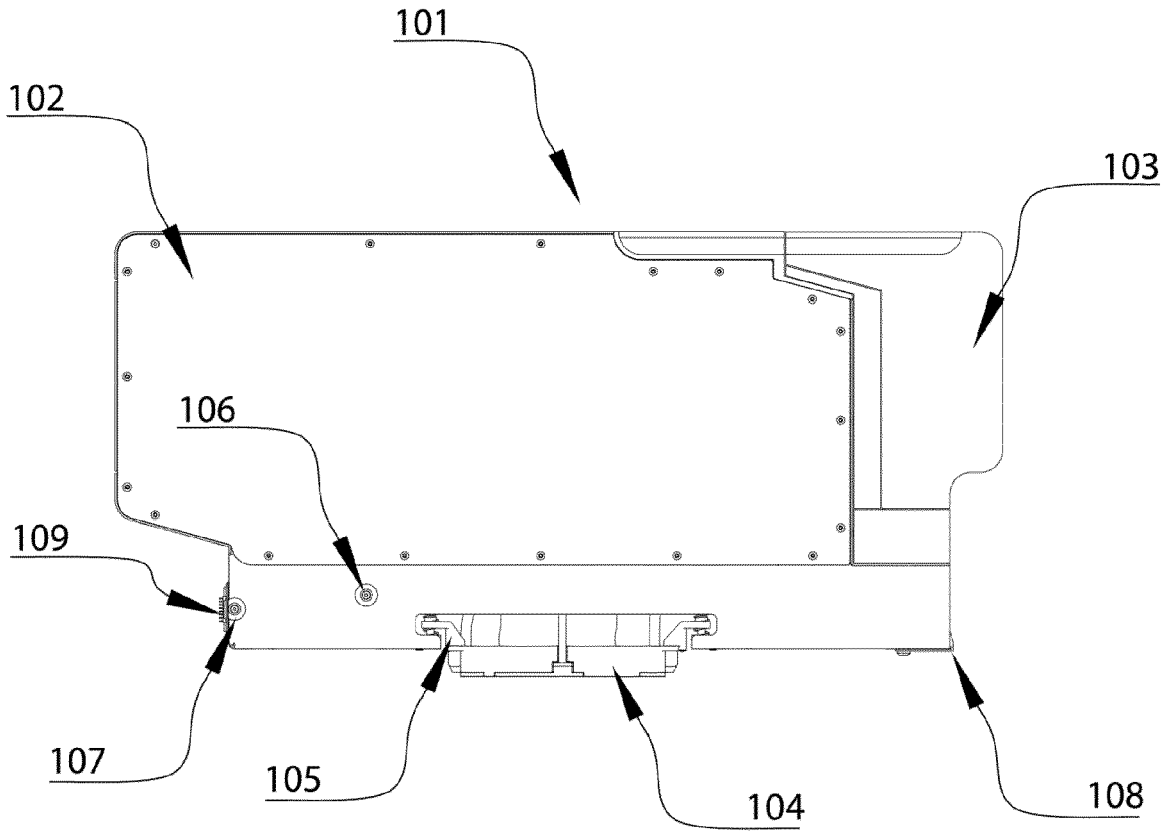


Fig. 2

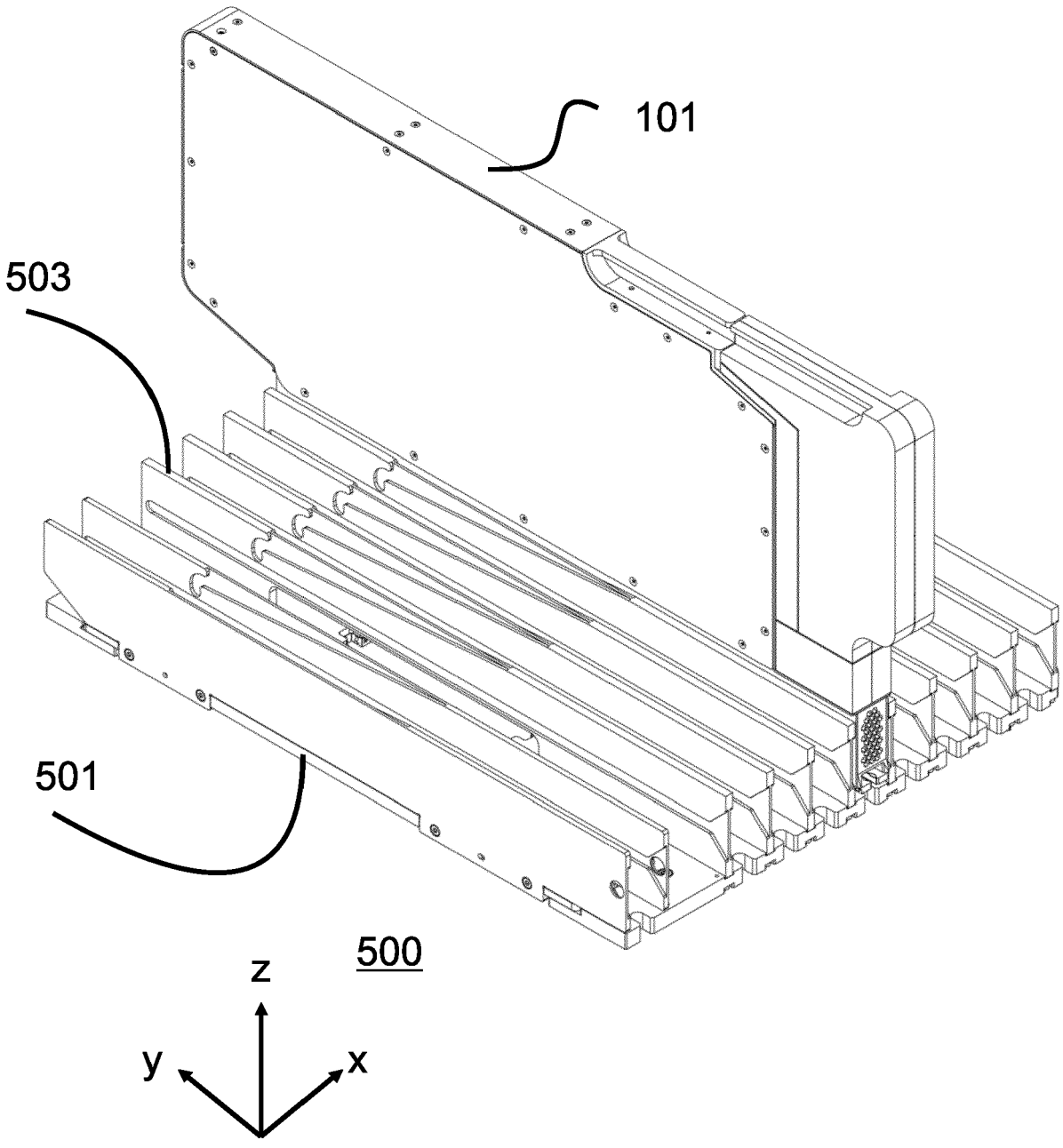


Fig. 3

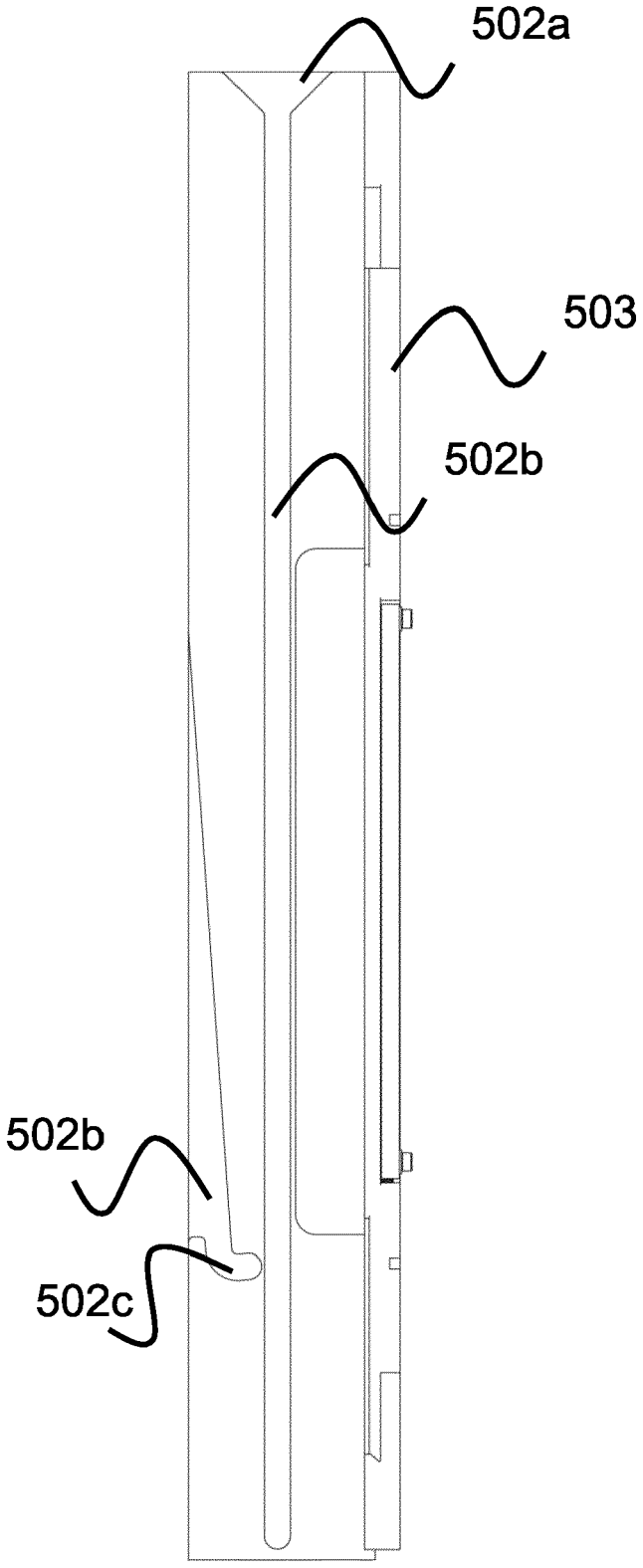


Fig. 4

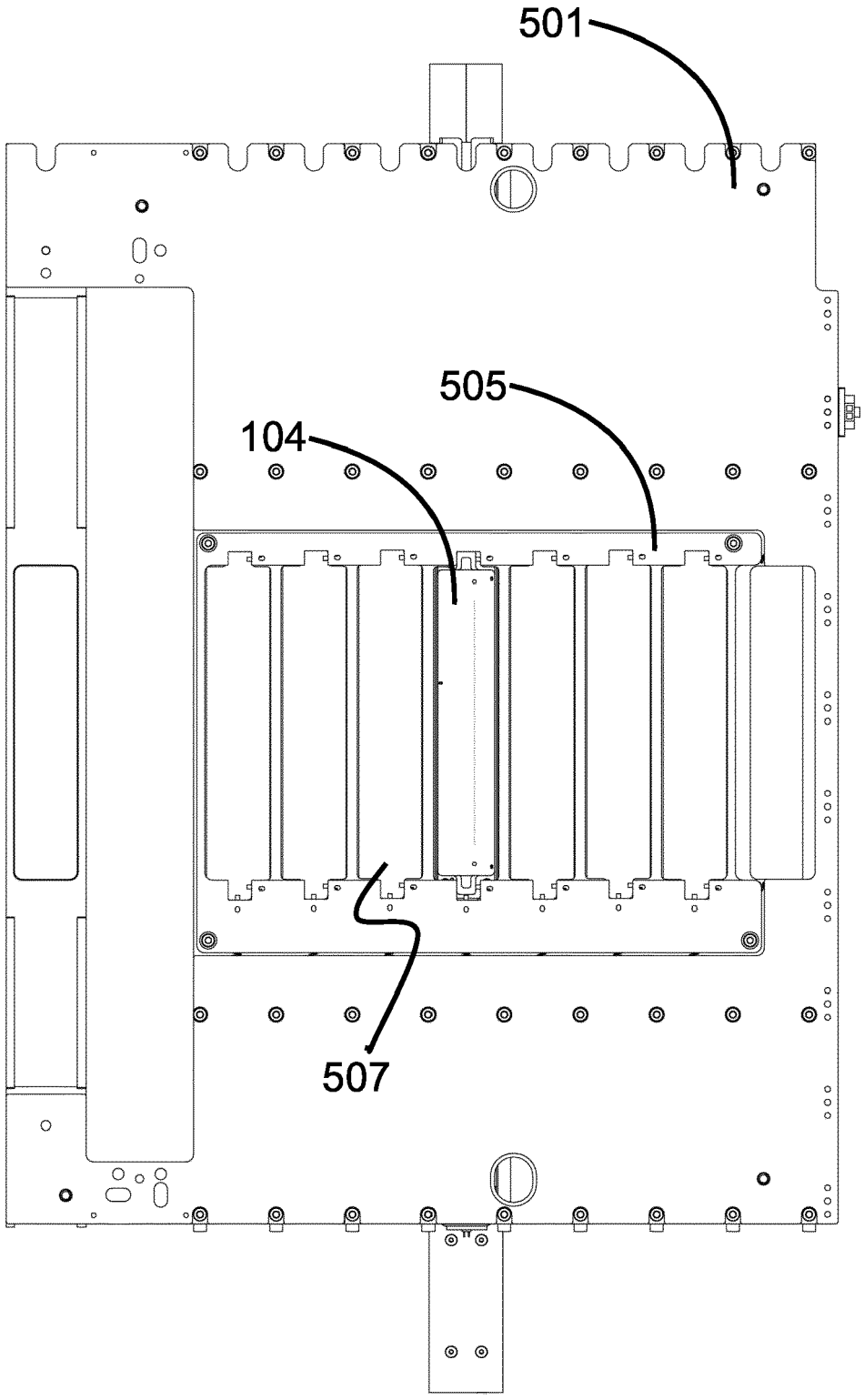


Fig. 5

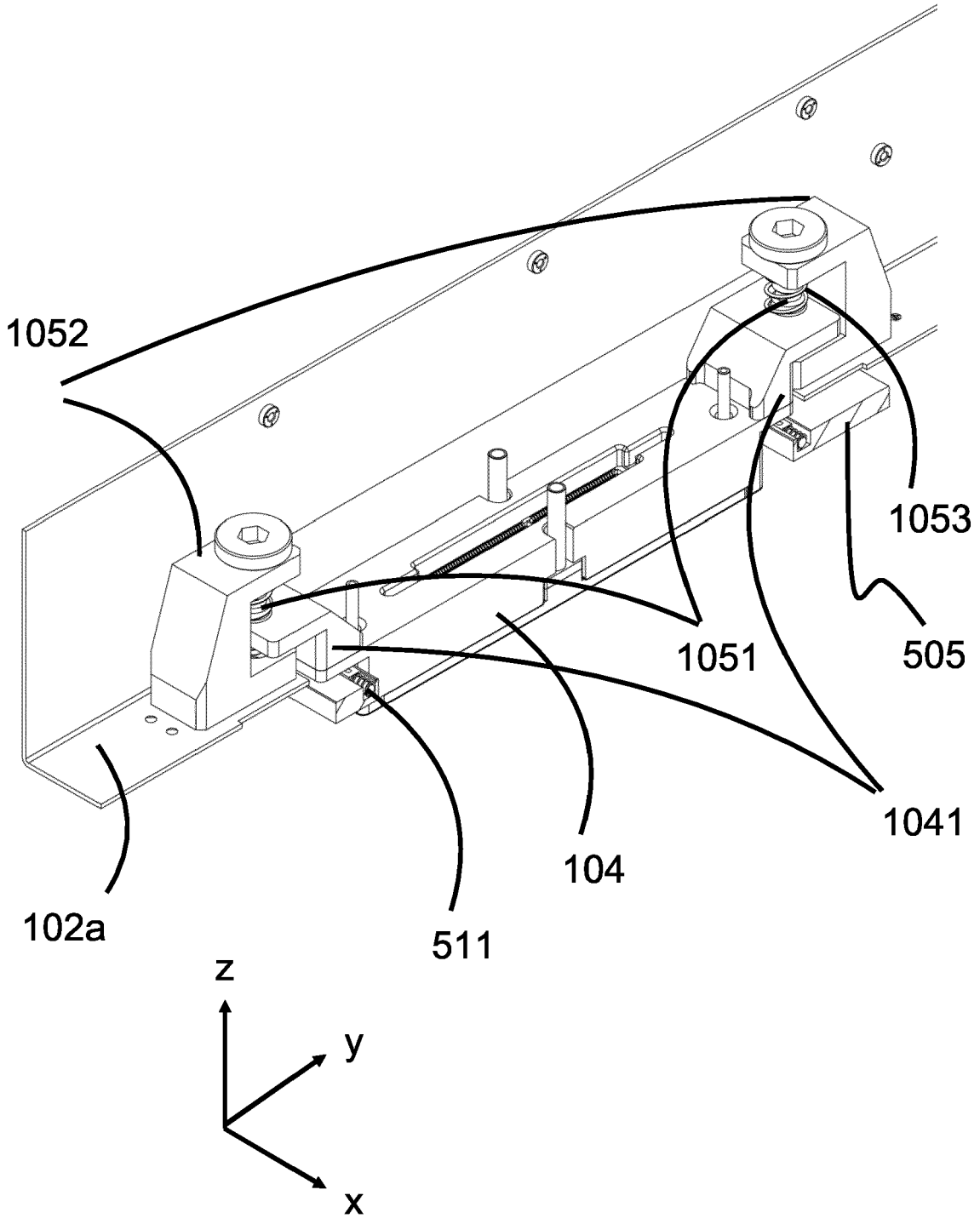


Fig. 6a

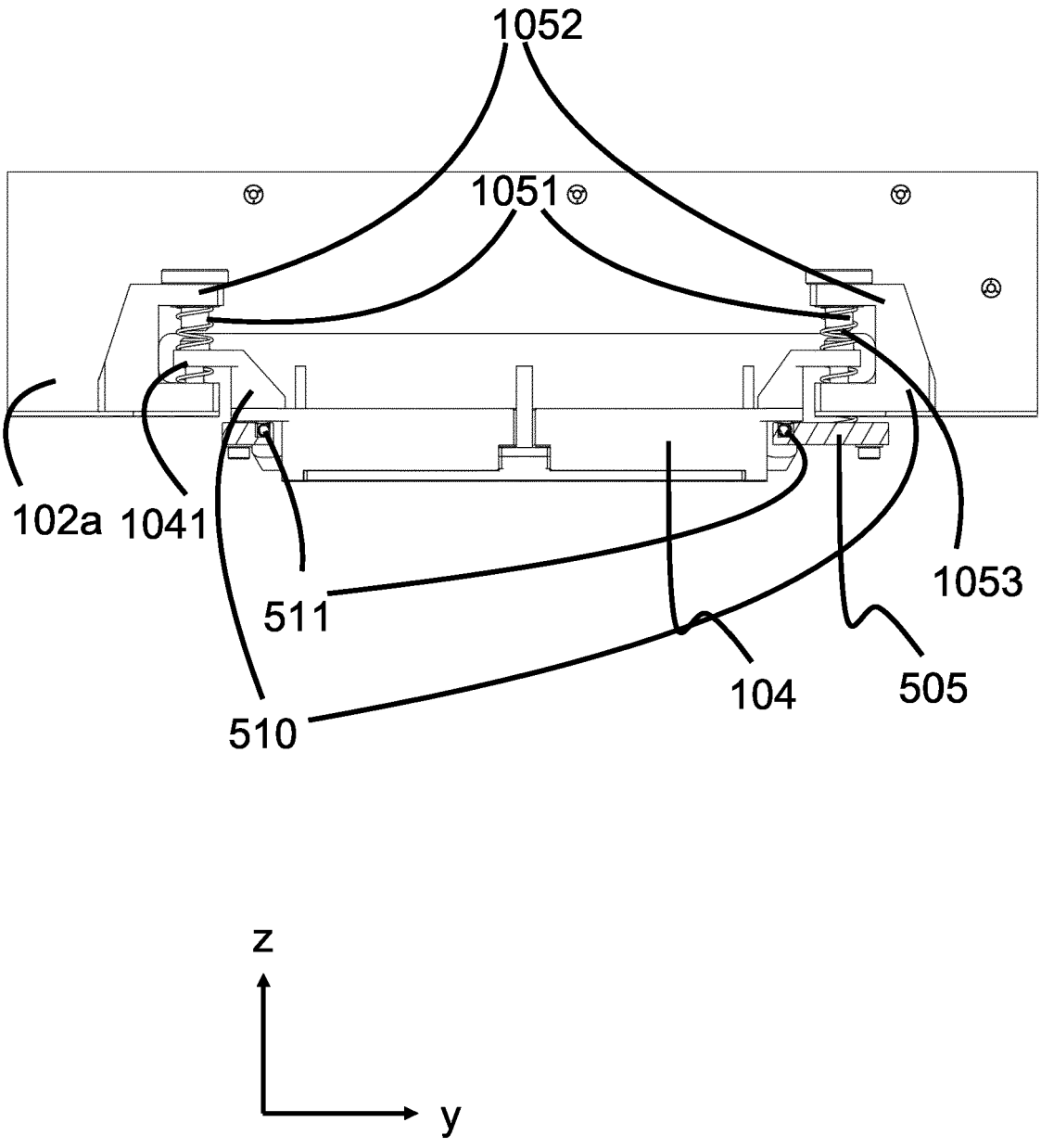


Fig. 6b

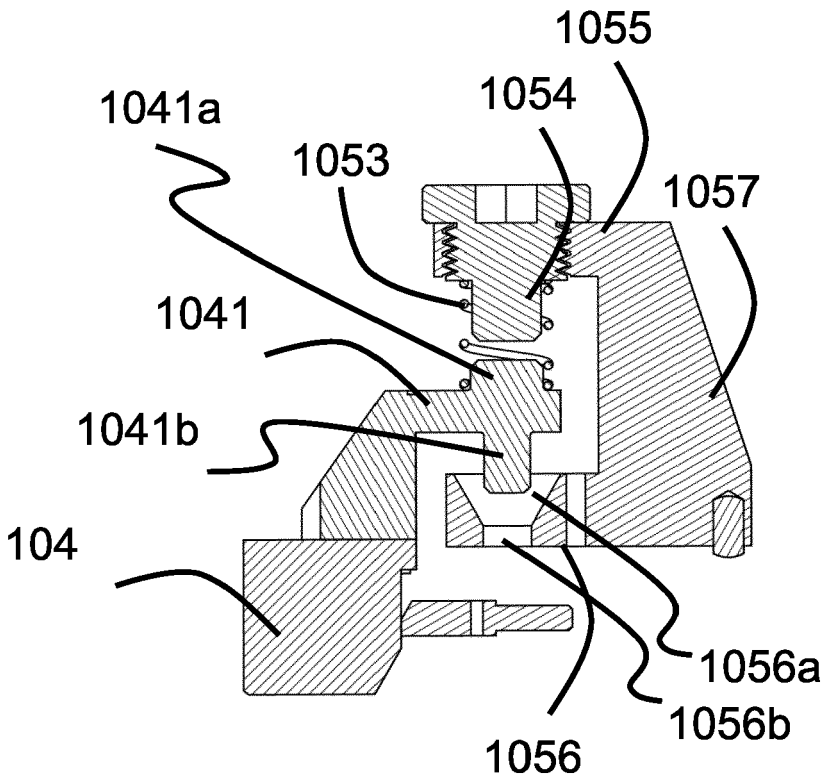


Fig. 7

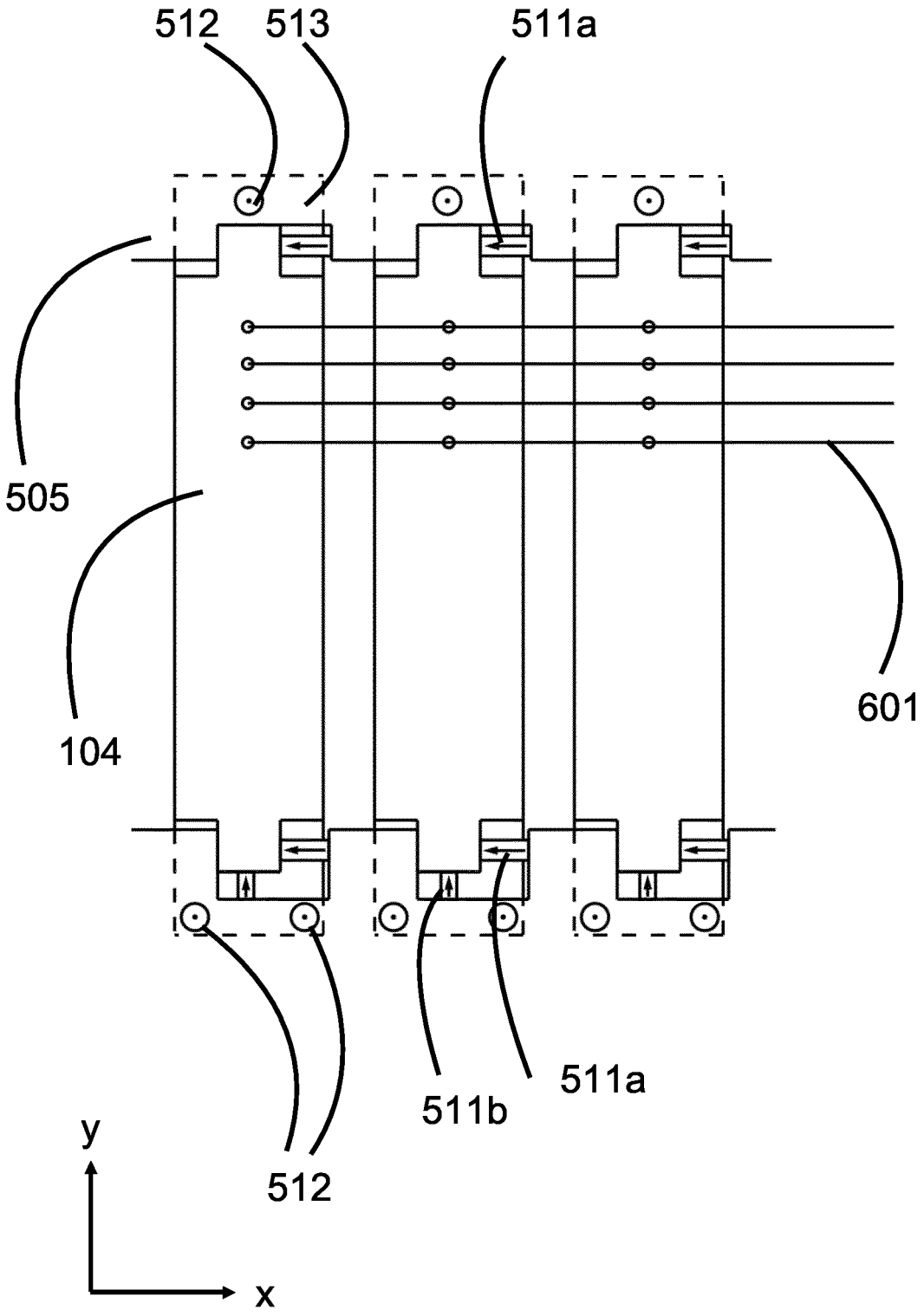


Fig. 8

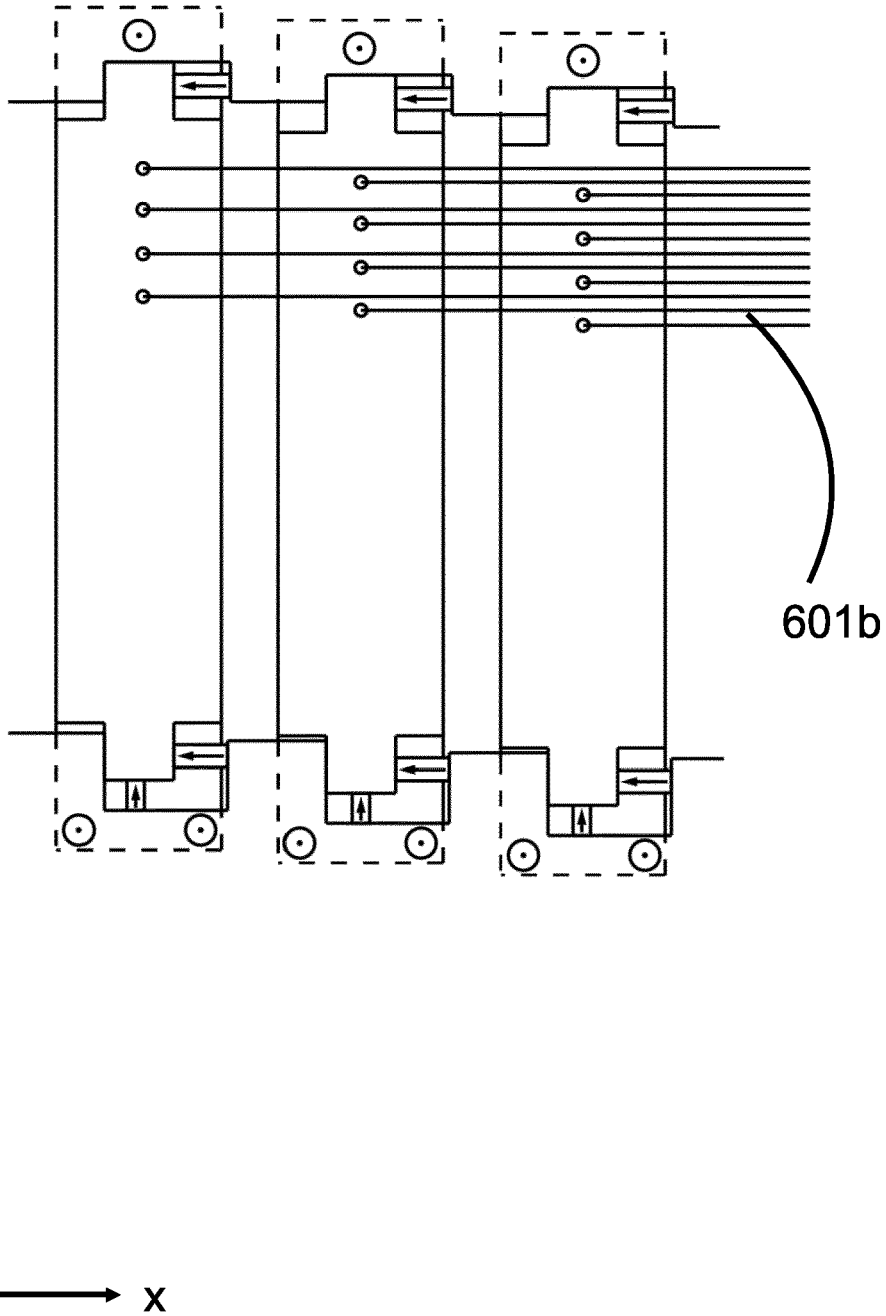
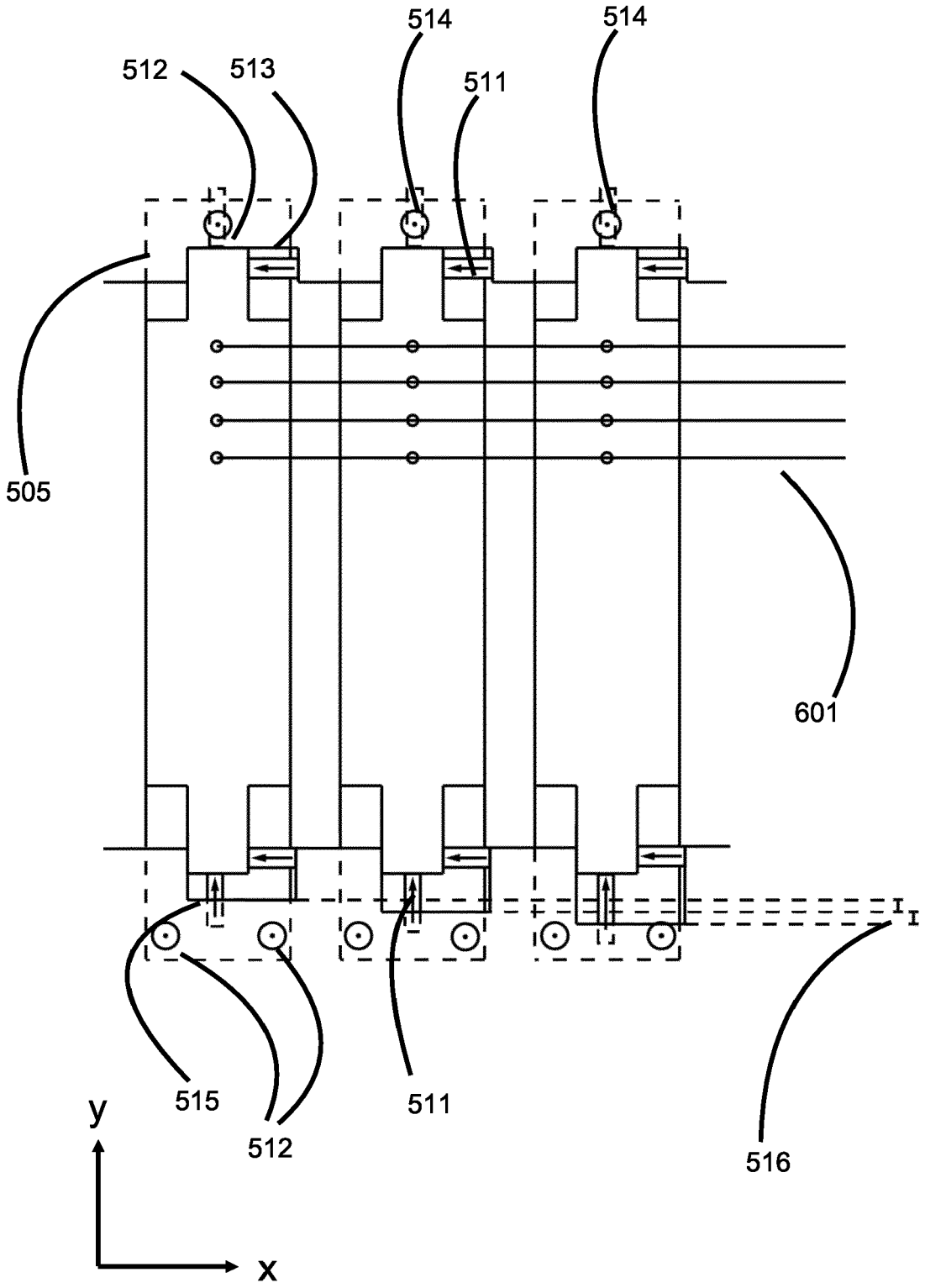


Fig. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 8060

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2008/170089 A1 (ALBERTALLI DAVID [US] ET AL) 17 July 2008 (2008-07-17)	1,2,6-12	INV. B41J25/00
A	* paragraphs [0053] - [0075], [0091] - [0113]; figures 1-6 *	3,4	B41J2/155 B41J2/175 B41J25/34

TECHNICAL FIELDS SEARCHED (IPC)

B41J

~~The present search report has been drawn up for all claims~~

Place of search	Date of completion of the search	Examiner
The Hague	5 April 2024	Hartmann, Mathias

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

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Application Number
EP 23 20 8060

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

1-4, 6-12

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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LACK OF UNITY OF INVENTION
SHEET B

Application Number
EP 23 20 8060

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-4, 6-12

1st invention (searched): printhead positioning

1.1. claim: 12

3rd invention (searched): increase print resolution

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2. claim: 5

2nd invention (not searched): insert print module into base plate

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Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 20 8060

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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05-04-2024

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008170089 A1	17-07-2008	CN 101198476 A	11-06-2008
		EP 1874550 A2	09-01-2008
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		US 2008170089 A1	17-07-2008
		WO 2006116574 A2	02-11-2006

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82