(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 389 426 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
26.06.2024 Bulletin 2024/26

(21) Application number: **22216291.9**

(22) Date of filing: **23.12.2022**

(51) International Patent Classification (IPC):
B41J 2/14 (2006.01) ***B41J 25/34*** (2006.01)

(52) Cooperative Patent Classification (CPC):
B41J 2/14233; B41J 25/34; B41J 2002/14241; B41J 2002/14491; B41J 2202/14; B41J 2202/19; B41J 2202/20

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

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(54) MOUNTING AND POSITIONING MEANS FOR A PRINTHEAD DEVICE

(57) The present invention provides a simple method for aligning droplet jetting devices when mounting these in a printer without the need for subsequent positional adjustment. The method comprising the steps of:
- Providing a carrier (80) comprising a first planar mounting surface (82);
- Providing a droplet jetting device (10) on the carrier (80) aligned with respect to the first planar mounting surface (82);
- Providing on the first mounting surface (82) a plurality of mounting spheres (72) of a predetermined diameter, wherein each mounting sphere (72) is inserted into a circular holder (74), and wherein the holders (74) are adhered to the first mounting surface (82), such that the mounting spheres (72) are in direct contact with the first mounting surface (82).

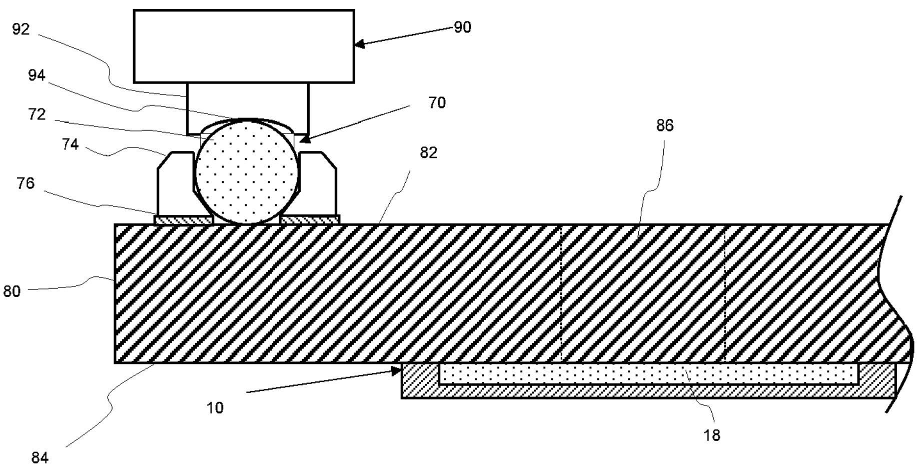

Fig. 5

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Description

BACKGROUND OF THE INVENTION

1. Field of the invention

[0001] The invention relates to a printhead device and a method for mounting such a printhead device in a printer.

2. Description of Background Art

[0002] A printhead device comprises at least one droplet jetting device. When multiple printhead devices are applied in a printer, these require alignment with respect to one another to ensure accurate positioning of all ink droplets on the print medium. It is known to provide printhead devices with mounting and positioning means that aid in the alignment of the printhead device with respect to the stationary frame of the printer. The known mounting and positioning means may comprise mounting spheres, as known from e.g. US 7401899 B2, and/or adjustment screws to align the printhead device with respect to the horizontal plane. The adjusting of the mounting and positioning means when mounting a printhead device is however time consuming. It was further found that during operation the initial alignment of known mounting and positioning means may be lost or reduced.

SUMMARY OF THE INVENTION

[0003] It is an object of the invention to provide an improved method of mounting and positioning a printhead device.

[0004] In accordance with the present invention, a method for mounting a printhead device according to claim 1, a printhead device according to claim 6, and a printer according to claim 15 are provided.

[0005] The method comprises the steps of:

- providing a carrier comprising a first planar mounting surface;
- providing a droplet jetting device on the carrier aligned with respect to the first planar mounting surface;
- providing on the first mounting surface a plurality of mounting spheres of a predetermined diameter, wherein each mounting sphere is inserted into a circular holder, and wherein the holders are adhered to the first mounting surface, such that the mounting spheres are in direct contact with the first mounting surface.

[0006] The diameter of each mounting sphere has been predetermined with great accuracy, for example by applying so-called high accuracy or high precision balls, which can be formed with a great degree of accuracy. Each mounting sphere is secured to the carrier, such that it is in direct contact with the first mounting surface. As the droplet jetting device is aligned with respect to the first mounting surface, the mounting spheres are also aligned with the first mounting surface and consequently with the droplet jetting device upon contact. The highest point of each mounting sphere is further accurately defined with respect to the first mounting surface and consequently the droplet jetting devices. Thus, the printhead device can be easily be aligned by mounting and positioning the mounting spheres in suitable predetermined receivers. For example, in case all the mounting spheres have the same diameter and the receivers are horizontally aligned, the droplet jetting devices of the printhead device will be horizontally aligned when the printhead device is mounted onto the receivers. No additional adjustments are required. An additional advantage is that the proposed method is relatively simple and low-costs to implement. 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, the step of processing the carrier further comprises forming a second planar mounting surface on the carrier parallel to the first mounting surface of the carrier and the step of providing the droplet jetting devices further comprises mounting the droplet jetting devices on the second mounting surface. To allow for a compact printhead device that may be closely spaced to the print medium without contact, the carrier is preferably provided with mounting surfaces on opposite sides of the carrier. The carrier is preferably a planar structure, such that two accurate, flat, and parallel mounting surfaces may be formed with a great degree of precision, for example by double-sided abrasion. The droplet jetting devices are mounted on the second mounting surface. By aligning the droplet jetting devices to the second mounting surface, they are aligned to the first mounting surface and consequently to the mounting spheres. Because the alignment is 'preserved', there is no need for adjustments in the positioning of the droplet jetting devices after mounting these in the receivers.

[0009] In an embodiment, the method according to the present invention further comprises the step of mounting the droplet jetting device in a printhead support of a printer, wherein the printhead support comprises a plurality of receivers, and wherein the mounting spheres are placed in their respective receivers. The receivers are connected to the frame of the printer in predetermined positions with high accuracy. In a preferred embodiment, the different receivers are mounted such that their receiving surfaces are positioned in the same horizontal plane during use. If then mounting spheres of the same diameter are applied, the first mounting surface and the droplet jetting device(s) become horizontally aligned when the mounting spheres have been inserted into their receivers.

[0010] In an embodiment, the mounting spheres are formed of a ceramic material and comprise the same diameter. Ceramic spheres or balls are commercially available with highly accurate diameters. Such spheres are generally formed of metal-oxides, such as zirconia, alumina, silica, etc. The metal-oxide composition further ensures a high hardness and rigidity to ensure that the mounting spheres maintain their shape during manufacturing and operation. It is further preferred that the coefficient of friction between the mounting spheres and their receivers on the printer is relatively low to allow for sliding contact to enable (re-)positioning of the mounting spheres. Preferably, the ceramic material is or comprises alumina (Al_2O_3).

[0011] In an embodiment, each holder and its respective mounting sphere in their assembled state comprise circular symmetry with respect to an axis perpendicular to the first mounting surface. Each mounting sphere and its holder when viewing top-down onto the first mounting surface looks the same when rotating to an arbitrary angle. The holder is preferably ring-shaped, such that when viewed from above the mounting sphere and its holder appear as a ring wherein the mounting sphere is received in the center. The circular symmetry ensures continued accurate positioning during operation, wherein the printhead device heats up and the mounting spheres and/or holders experience thermal expansion. The mounting spheres and holders are each circularly symmetric, so their thermal expansion is substantially the same in all directions parallel to the first mounting surface. In consequence, the accuracy of positioning is not affected, since the thermal expansion, stresses, strains, and deformations are the same in all directions parallel to the first mounting surface. The droplet jetting devices thus are not shifted in position due to heating in the printhead device.

[0012] In a further aspect, the present invention relates to a printhead device comprising at least one droplet jetting device arranged on a carrier, which carrier comprises a plurality of mounting surface areas provided in fixed, predetermined positions and orientations with respect to one another and to the at least one droplet jetting device, wherein a mounting sphere with a predetermined radius being mounted at each mounting surface area, wherein each mounting sphere is held in direct contact with its respective mounting surface area by means of its respective holder. Each mounting sphere is positioned directly onto its respective mounting surface area. The mounting surface areas have an accurately defined, positional relation within one another. In one example, the mounting surface areas are all positioned within a single flat plane. In a more complicated embodiment, the mounting surface areas may be provided out of plane with one another, but their relative positional vectors have been accurately predetermined, for example by forming the different areas with accurate processes, such as MEMS processing. Since the mounting spheres have accurate and predetermined diameters, the positional relation between the tops of the mounting spheres and the at least one droplet jetting device is accurately defined. Thus, by mounting the mounting spheres on prepositioned receivers, the printhead device can be accurately positioned with respect to the receivers. Preferably, all mounting spheres have the same radius, so that the plane defined by their highest points (measured from their mounting surface area) is parallel to the plane defined by said mounting surface areas. In case the mounting surface areas are positioned within the same plane, for example by being part of a single first mounting surface, then same diameter mounting spheres ensure that the plane defined by their tops is parallel to said plane, which is also parallel to the droplet jetting device. By mounting the mounting spheres on the receivers, the droplet jetting device will be aligned parallel to a plane defined by the receivers, which is preferably horizontal.

[0013] In an embodiment, each holder extends fully circumferentially around its respective mounting sphere. The holder like the mounting is preferably circular symmetric when viewed perpendicular to the respective mounting surface area. This ensures that thermal expansion affects each holder and mounting sphere in a circular symmetric manner, thereby reducing the chance of shifting of the droplet jetting device due to thermal effects. In a preferred embodiment, each holder is a clamping ring. The clamping ring has a central opening with a cross-sectional diameter slightly smaller than that of the respective mounting sphere. Thereby, the mounting sphere can be securely attached to the holder in a simple and reliable manner, by e.g. pressing. Preferably, the mounting sphere is inserted into the holder, so that it extends beyond a mounting surface on a side of the holder which faces the mounting surface area after assembly.

[0014] In an embodiment, each clamping ring is adhered to its respective mounting surface area by means of an adhesive. The adhesive is applied between the mounting surface of the holder, which mounting surface faces the mounting surface area on the carrier. The area or zone where the mounting sphere is to contact the mounting surface area is free of adhesive, so that there is direct contact between the two. The adhesive is preferably applied circumferentially around, but not in this contact region.

[0015] In embodiment, all mounting surface areas are positioned in a single, flat plane on a first mounting surface of the carrier. The flat plane defines a single first mounting surface, which is a flat or straight plane which comprises all the mounting surfaces areas. The first mounting surface can be easily and accurately formed, for example by abrasion. By forming all mounting surface areas on the carrier as a single first mounting surface, the mounting surface areas are easily aligned with respect to one another. If combined with same diameter mounting spheres, an easy mounting and positioning means are achieved that accurately transfer the alignment of the droplet jetting devices.

[0016] In an embodiment, the carrier further comprises a second flat surface parallel to the first surface, upon which second surface the droplet jetting devices are mounted. The second mounting surface is preferably on an opposite side of the carrier to create a space efficient printhead device, which allows the droplet jetting devices to be positioned close to the print medium (with a so-called small print gap spacing). Parallel and accurate first and second mounting surfaces may be easily formed by for example double-sided abrasion of the carrier. The carrier is preferably formed as a planar structure, wherein the first and second mounting surfaces are the largest surfaces on the carrier on opposing sides. The droplet jetting devices are mounted onto the second mounting surface in alignment therewith. In consequence, the droplet jetting devices are aligned with the first mounting surface and then also accurately with the mounting spheres and the receivers wherein these are mounted.

[0017] In an embodiment, the printhead device according to the present invention comprises three mounting spheres. To achieve positional stability preferably three mounting spheres are applied as mounting and positioning means. Additional means for fixing the printhead device onto the receivers may be provided, but these preferably only incur a holding force perpendicular to the first mounting surface, while the position of the printhead device with respect to the receivers is entirely determined by the mounting spheres. In another embodiment, the mounting spheres are formed of a ceramic material.

[0018] A further aspect of the present invention relates to a printer comprising a printhead device as described above. The printer preferably comprises a plurality of said printhead devices, for example to form a page-wide printhead array. By applying the above mentioned method or design the different printhead devices and specifically their droplet jetting devices can be easily and accurately aligned with one another and/or to the same horizontal plane during use.

[0019] 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 preferred embodiments of the present invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the present invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The present invention will become more fully understood from the detailed description given herein below and the accompanying 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 cross-sectional view of a droplet jetting device for a printhead device;
- Fig. 2 is schematic cross-sectional view of a carrier of a droplet jetting device upon which carrier a droplet jetting has been mounted and aligned;
- Fig. 3 is a schematic cross-sectional view of the carrier in Fig. 2 in the step of mounting the mounting and positioning means on the carrier;
- Fig. 4 is a schematic cross-sectional view of the carrier in Fig. 3 wherein the mounting and positioning means have been adhered on the carrier;
- Fig. 5 is a schematic cross-sectional view of the carrier in Fig. 4 in the step of positioning the mounting and positioning means in their respective holder on the printer; and
- Fig. 6 is schematic cross-sectional view of the carrier in Fig. 4.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] 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.

<u>Droplet jetting device</u>

[0022] Fig. 1 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 ink jet 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. Such a droplet jetting device 10 is known from US 10391768 B2, the description of which is herein incorporated by reference.

[0023] The distribution layer 12 is a single silicon layer having a relatively large thickness of at least 400 micron. The distribution layer 12 defines an ink 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 which has been shown only schematically in Fig. 1 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.

[0024] 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 ink supply line 18 so as to connect the ink 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.

[0025] 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 °2 has been removed.

[0026] 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. 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.

[0027] 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.

[0028] When the actuator 32 performs a suction stroke, ink is sucked in from the ink 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 ink 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 ink supply line 18. To that end, the ink 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.

[0029] In the example shown, the restrictor 56 extends between a trench 58 and a restrictor cavity 60, forming an end part of the ink 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 trench 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.

[0030] As has been shown in Fig. 1, 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.

[0031] A plurality of droplet jetting devices 10 is to be mounted in a printer to form a printhead array. The different droplet jetting devices 10 need to be aligned with one another in terms of positions and orientations to ensure that the jetted droplets are accurately deposited. Misalignment of a droplet jetting device 10 with respect to the others may result in visible print artifacts in the printed products. Thereto, one or more droplet jetting devices 10 are provided on a carrier 80, which is provided with mounting and positioning means 70 for mounting the at least one droplet jetting device 10 accurately in a printer. Figs. 2 to 5 illustrate the steps of an easy and low-costs accurate method for positioning of droplet jetting devices 10 in a printer.

Mounting and positioning means

[0032] Fig. 2 illustrates the step of providing a carrier 80 and mounting at least one droplet jetting device 10 thereon. The carrier 80 comprises two planar mounting surfaces 82, 84, which are parallel to one another. The top and bottom mounting surfaces 82, 84 are in alignment with one another and have both been processed to have a high degree of flatness. The mounting surfaces 82, 84 are very flat and have been very accurately aligned with respect to one another, so that these are parallel. In the example of Fig. 3, the carrier 80 is preferably formed of a ceramic substrate, which has been processed by grinding, specifically double-sided grinding to form the two flat, parallel mounting surfaces 82, 84. Double-sided grinding is an accurate, relatively low-costs, and efficient method of forming two parallel mounting surfaces 82, 84 on the carrier 80. Suitable materials for the carrier 80 may include metal-oxides or other suitable hard materials.

[0033] One of the planar mounting surfaces 82, 84 is arranged for mounting the droplet jetting devices 10 thereon, while the other of the mounting surfaces 82, 84 is designed to hold the mounting and positioning means 70. The droplet jetting devices 10 preferably comprise also a planar mounting surface of their own, which allows the droplet jetting devices 10 to be accurately mounted on their respective carrier 80. Thereby, different droplet jetting devices 10 can be accurately aligned onto the carrier 80, as shown in Fig. 6. The droplet jetting devices 10 are mounted on the second mounting surface 84 (bottom surface in Fig. 2) of the carrier 80, such that each droplet jetting device 10, specifically its row(s) of nozzles 50, is parallel to the second mounting surface 84 of the carrier 80. In their mounted state, the ink supply line 18 of the droplet jetting device 10 is in fluid connection to a respective distribution channel 86 in the carrier 80 that allows fluid to be distributed via the carrier 80 to all mounted droplet jetting devices 10.

[0034] Fig. 3 illustrates the step of providing the mounting and positioning means 70. The mounting and positioning means 70 comprise a mounting sphere 72 inside a holder 74. The mounting sphere 72 is shaped as a ball formed with a high degree of roundness. Preferably, the mounting spheres are formed of a ceramic material, such as metal-oxides. Commonly used materials, include zirconia, alumina, glass (silicon-oxide), etc. Such mounting spheres 72 are commercially available as "(high) precision balls" or "(high) accuracy balls" and may be accurately formed by processes as known in the state of the art, such as V-groove plate methods, including e.g. concentric, eccentric, and/or spiral V-groove plate methods, controllable ball-spin angle methods, and magnetic abrasive slurry processing methods. The mounting spheres 72 have further been formed with a highly accurate diameter, which due to their roundness is accurately the same over the entire surface of the mounting sphere 72.

[0035] The mounting sphere 72 in Fig. 3 is secured into its holder 74. The holder 74, as can be seen in Fig. 6, comprises an annular clamping ring, which after assembly extends entirely circumferentially around the mounting sphere 72. The holder 74 has circular symmetry with respect to an axis parallel to the direction in which the mounting sphere 72 is inserted into the holder 74. The holder 74 comprises a central opening for receiving the mounting sphere 74 therein. The central opening 74 has a circular cross-section with an initial diameter slightly smaller than the predetermined diameter of the mounting sphere 72. The mounting sphere 72 in Fig. 3 is pressed into the central opening of the holder 74, such that the mounting sphere 72 is clamped and thereby secured in the holder 74. Heating and cooling may be applied to ease insertion and/or improve the clamping. The mounting sphere 72 is pressed into holder 74, such that its contact portion 73 extends beyond the mounting surface 76 of the holder 74. The holder 74 may be formed of any suitable material, such as metal, ceramics, etc.

[0036] Fig. 4 illustrates the step of securing the mounting spheres 72 onto the carrier 80. An adhesive 78 is provided on the mounting surface 76 of the holder 74 or onto the corresponding area of the first mounting surface 82 of the carrier 80. The adhesive 78 is applied such that the contact portion 73 of the mounting sphere 72 remains free of adhesive 78. The mounting sphere 72 is then brought into direct contact with the first mounting surface 82 of the carrier 80: no adhesive 78 is present between the contact portion 73 and the first mounting surface 82. The holder 74 is secured to the first mounting surface 82 by means of the adhesive 76. The adhesive 78 may be further treated by curing, annealing, and/or heating to facilitate a strong binding of the holder 74 to the carrier 80. The mounting sphere 72 clamped in the holder 74 is thereby secured to the carrier 80. Since the contact portion 73 of the mounting sphere 72 is in direct contact with the first mounting surface 82 and the diameter of the mounting sphere 72 has been determined with high accuracy, highly accurate mounting and positioning means are formed. The height of the mounting sphere 72 measured perpendicular to the second surface 82 is equal to the diameter of the mounting sphere 72, which was formed with a high degree of precision. The plane defined by the tops of the mounting spheres 72 is then also accurately defined. Since in this example, all mounting spheres 72 have the same diameter, this plane is parallel to the first and second mounting surfaces 82, 84 and to the droplet jetting devices 10. While the height of the mounting spheres 72 measured perpendicular to the first mounting surface 82 has thus been very accurately determined, the in-plane position of the mounting sphere 72 parallel to the first mounting surface 82 need not be determined with the same degree of accuracy in this step. For example, the holders 74 may be adhered using a known glue mold or glue template. The mounting spheres 72 and their holders 74 are mounted first onto the carrier 80. In a following step the droplet jetting device 10 are mounted onto the carrier 80 based on the positions of the mounting spheres 72. In this example, the in-plane position of the droplet jetting devices 10 is aligned with respect to the mounting spheres 72 already secured to the carrier 80. This allows for easy and swift mounting of the mounting spheres 72 and holders 74. The droplet jetting devices 10 can be accurately positioned using known alignment processes from e.g. MEMS processing.

[0037] It will be appreciated that in another embodiment the holder 74 may first be adhered to the carrier 80, after which the mounting sphere 72 is pressed into the holder 74. The adhesive 78 may be applied to the first mounting surface 82, to the holder 72, or both, as long as it is ensured that the contact portion 73 of the mounting sphere 72 is free of adhesive 78 in the assembled state, so that there is direct contact between the mounting sphere 72 and the first mounting surface 82.

[0038] In Fig. 5, the mounting and positioning means are positioned in their respective receivers 92. The receivers 92 are accurately positioned on the frame 90 of the printer. The frame may be in the form of a printhead support which extends page-wide over the printing area of the printer. Each receiver 92 comprises a receiving surface 94 against which the mounting sphere 72 is pressed. Locking means (not shown) ensure that the mounting spheres 72 remain in contact with their receivers 92. In this example, the receivers 92 have been mounted aligned in the same horizontal plane.

[0039] Since the diameter of the mounting sphere 72 was determined with great accuracy, the distance between the receiving surface 94 and the second surface 82 is also accurately determined. This holds for all the mounting and positioning means show in Fig. 6: at every mounting sphere 72 the distance between its respective receiver 92 and the second surface 82 there is determined by the diameter of the mounting sphere 72. In case all mounting spheres 72 have the same accurate diameter, this ensures that the second surface 82 is parallel to the plane defined by the receivers 92. Since the first surface 84 is parallel to the second surface 82 and the fact that the droplet jetting devices 10 are mounted parallel to the first surface 84, this results in the droplet jetting device becoming accurately aligned with the printhead support frame 90 of the printer. There is no need for adjustment of the mounting and positioning means to ensure alignment. In this example, the receivers 92 aligned in the same (horizontal) plane and all mounting spheres 72 comprise the same diameter. Upon contact between the mounting spheres 72 and the receivers 92, the droplet jetting devices 10 are brought parallel to the plane defined by the receivers 92. Accurate alignment is achieved without the need for further adjustment or tuning.

[0040] An additional advantage of the present invention is its continued accuracy during operation. Heat generated inside the printhead device causes the mounting and positioning means to heat up, resulting in thermal expansion of the mounting and positioning means. The mounting and positioning means in Fig. 6 are formed circularly symmetric with respect to an axis perpendicular to the second surface 82. In consequence, the mounting and positioning means expand equally in all in-plane directions in Fig. 6, thereby preventing shifting the position of the droplet jetting devices 10, when operational temperatures increase.

[0041] Although specific embodiments of the invention are illustrated and described herein, it will be appreciated by those of ordinary skill in the art that a variety of alternate and/or equivalent implementations exist. It should be appreciated that the exemplary embodiment or exemplary embodiments are examples only and are not intended to limit the scope, applicability, or configuration in any way. Rather, the foregoing summary and detailed description will provide those skilled in the art with a convenient road map for implementing at least one exemplary embodiment, it being understood that various changes may be made in the function and arrangement of elements described in an exemplary embodiment without departing from the scope as set forth in the appended claims and their legal equivalents. Generally, this application is intended to cover any adaptations or variations of the specific embodiments discussed herein.

[0042] It will also be appreciated that in this document the terms "comprise", "comprising", "include", "including", "contain", "containing", "have", "having", and any variations thereof, are intended to be understood in an inclusive (i.e. non-exclusive) sense, such that the process, method, device, apparatus or system described herein is not limited to those features or parts or elements or steps recited but may include other elements, features, parts or steps not expressly listed or inherent to such process, method, article, or apparatus. Furthermore, the terms "a" and "an" used herein are intended to be understood as meaning one or more unless explicitly stated otherwise. Moreover, the terms "first", "second", "third", etc. are used merely as labels, and are not intended to impose numerical requirements on or to establish a certain ranking of importance of their objects.

[0043] The present 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 present 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 of mounting a printhead device comprising the steps of:

   - Providing a carrier (80) comprising a first planar mounting surface (82);
   - Providing a droplet jetting device (10) on the carrier (80) aligned with respect to the first planar mounting surface (82);
   - Providing on the first mounting surface (82) a plurality of mounting spheres (72) of a predetermined diameter, wherein each mounting sphere (72) is inserted into a circular holder (74), and wherein the holders (74) are adhered to the first mounting surface (82), such that the mounting spheres (72) are in direct contact with the first mounting surface (82).

2. The method according to claim 1, wherein the step of processing the carrier (80) further comprises forming a second planar mounting surface (84) on the carrier (80) parallel to the first mounting surface (82) of the carrier (80) and the step of providing the droplet jetting devices (10) further comprises mounting the droplet jetting devices (10) on the second mounting surface (84).

3. The method according to any of the previous claims, further comprising the step of mounting the printhead

device in a printhead support (90) of a printer, wherein the printhead support comprises a plurality of receivers (92), and wherein the mounting spheres (72) are placed in their respective receivers (92).

4. The method according to any of the previous claims, wherein the mounting spheres (72) are formed of a ceramic material and comprise the same diameter.

5. The method according to any of previous claims, wherein each holder (74) and its respective mounting sphere (72) in their assembled state comprises circular symmetry with respect to an axis perpendicular to the first mounting surface (82).

6. A printhead device comprising at least one droplet jetting device (10) arranged on a carrier (80), which carrier (80) comprises a plurality of mounting surface areas provided in fixed, predetermined positions and orientations with respect to one another and to the at least one droplet jetting device (10), **characterized by** a mounting sphere (72) with a predetermined radius being mounted at each mounting surface area, wherein each mounting sphere (72) is held in direct contact with its respective mounting surface area by means of its respective holder (74).

7. The printhead device according to claim 6, wherein all mounting spheres (72) have the same radius.

8. The printhead device according to claim 6 or 7, wherein each holder (74) extends fully circumferentially around its respective mounting sphere (72).

9. The printhead device according to claim 8, wherein each holder (74) is a clamping ring.

10. The printhead device according to claim 9, wherein each clamping ring is adhered to its respective mounting surface area by means of an adhesive.

11. The printhead device according to any of the claims 6 to 10, wherein all mounting surface areas are positioned in a single, flat plane on a first mounting surface (82) of the carrier.

12. The printhead device according to claim 11, wherein the carrier (80) further comprises a second flat mounting surface (84) parallel to the first mounting surface (82), upon which second mounting surface (84) the at least one droplet jetting device (10) has been mounted.

13. The printhead device according to any of the claim 6 to 12, comprising three mounting spheres (72).

14. The printhead device according to claim 13, wherein the mounting spheres (72) are formed of a ceramic material.

15. A printer comprising a printhead device according to any of the claims 6 to 14.

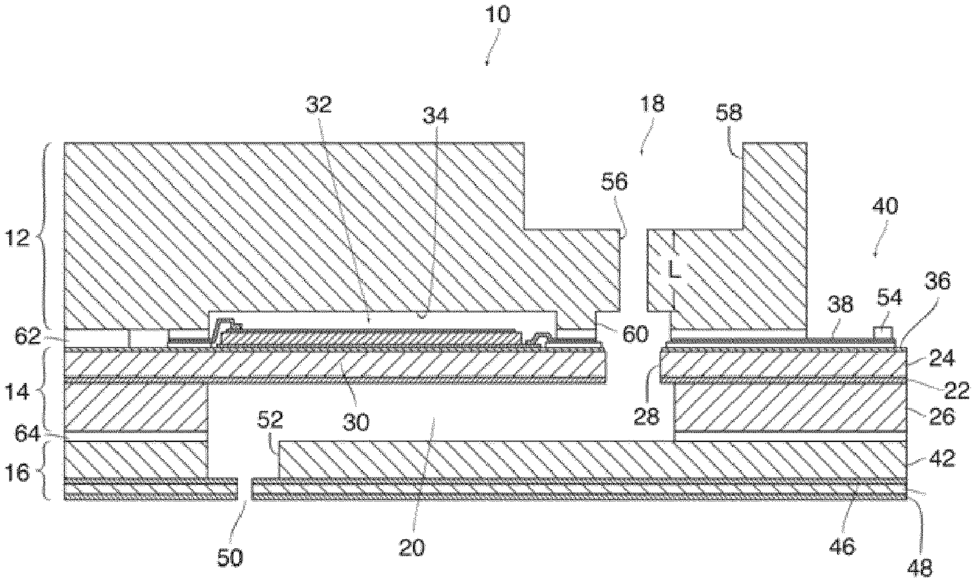
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Fig. 1

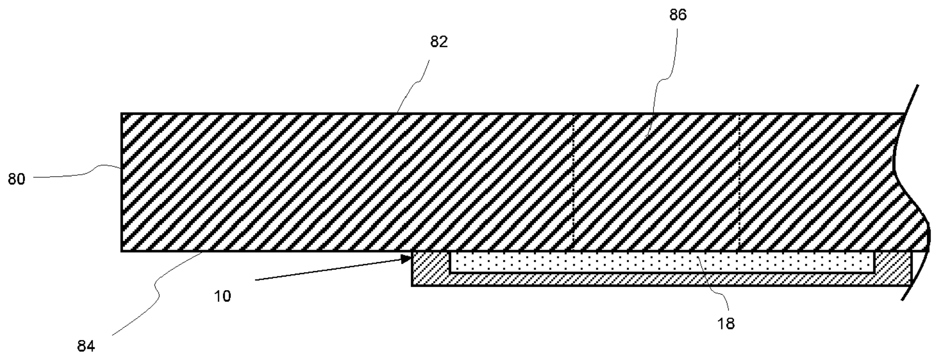

Fig. 2

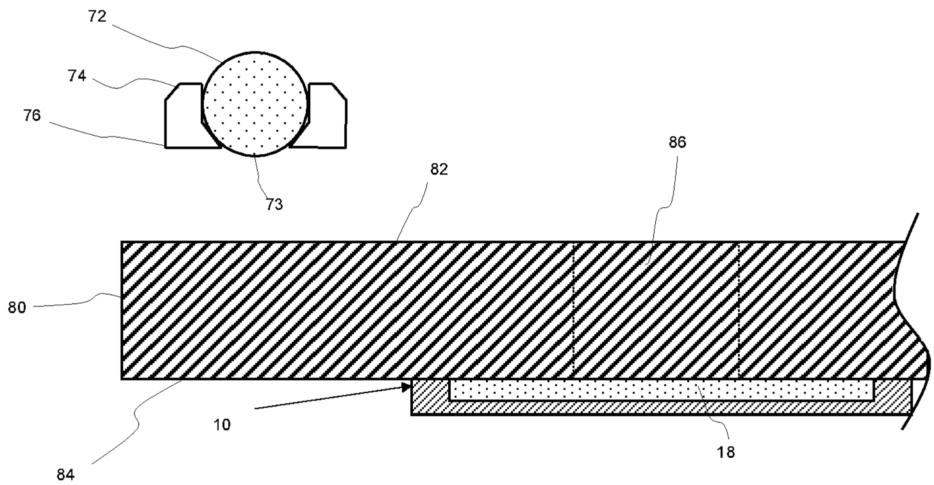

Fig. 3

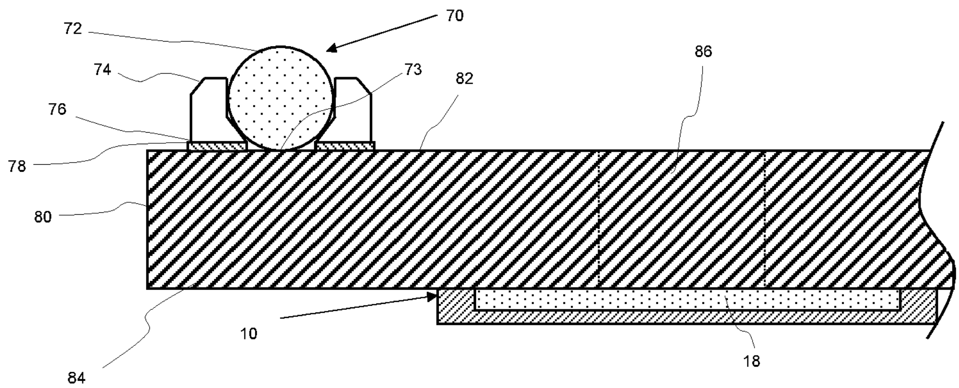

Fig. 4

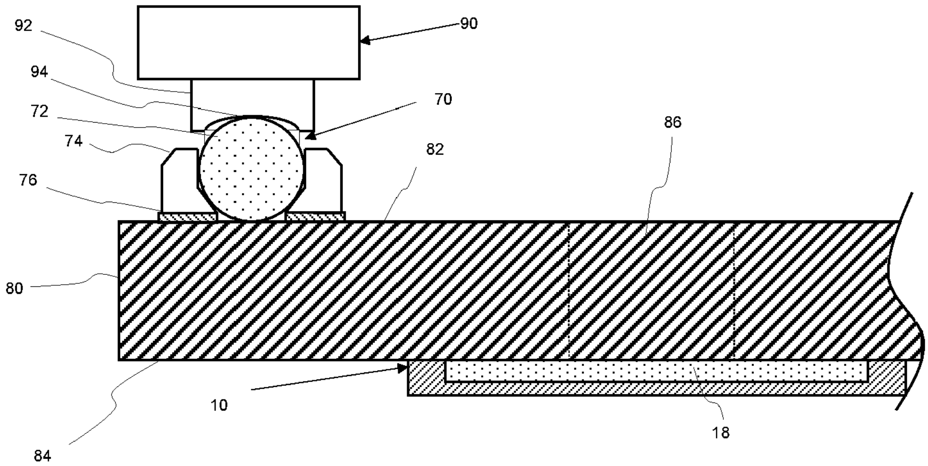
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Fig. 5

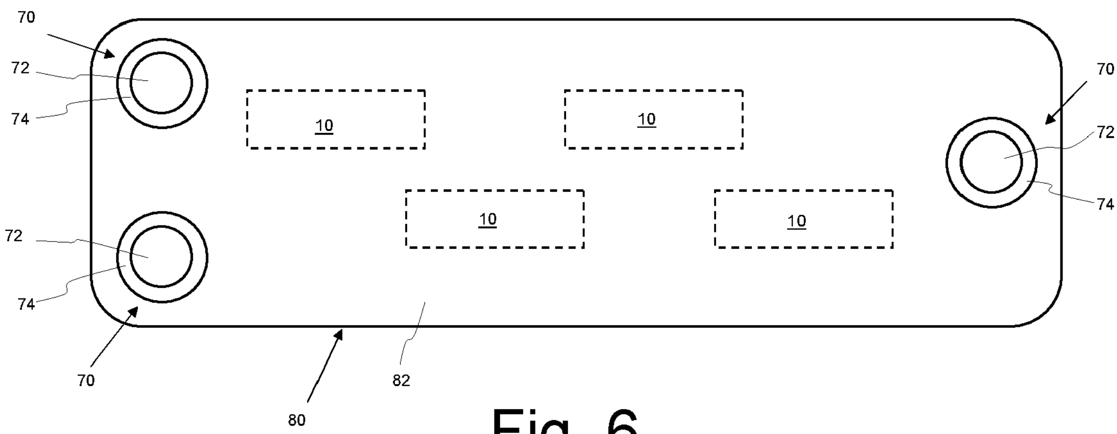
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Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 6291

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 Y A	US 2011/316933 A1 (FISHKIN MIKHAIL [US] ET AL) 29 December 2011 (2011-12-29) * paragraphs [0024], [0026], [0030]; figures 1-4 * -----	1,4-9, 11,13-15 2,3,12 10	INV. B41J2/14 B41J25/34
Y	US 2014/168293 A1 (MOREAU JEAN-MICHEL [CH] ET AL) 19 June 2014 (2014-06-19) * paragraph [0082]; figures 6,8 * -----	2,3,12	
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	5 June 2023	Öztürk, Serkan

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05-06-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011316933 A1	29-12-2011	CN 102947098 A	27-02-2013
		EP 2585300 A1	01-05-2013
		US 2011316933 A1	29-12-2011
		WO 2011162976 A1	29-12-2011
US 2014168293 A1	19-06-2014	US 2014168293 A1	19-06-2014
		US 2014362132 A1	11-12-2014

EPO FORM P0459

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Patent documents cited in the description

- US 7401899 B2 **[0002]**
- US 10391768 B2 **[0022]**