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(54) INKJET PRINT HEAD ASSEMBLY AND METHOD OF MANUFACTURING SUCH INKET PRINT HEAD

(57) An inkjet print head assembly comprises a MEMS-manufactured inkjet chip, a print head base element and a damper element. The MEMS-manufactured inkjet chip is provided with a number of ejection units, each comprising a nozzle and a liquid supply port, wherein the liquid supply ports are arranged in a second chip surface. The print head base element has a liquid supply recess, the inkjet chip being arranged on the print head base element over the liquid supply recess. The second chip surface faces the liquid supply recess such that the liquid supply ports are in fluid communication with the liquid supply recess. The damper element comprising a flexible wall arranged over a closed hollow space and is arranged in the liquid supply recess. The flexible wall faces the liquid supply ports and is arranged at a predetermined damper distance from the second chip surface.

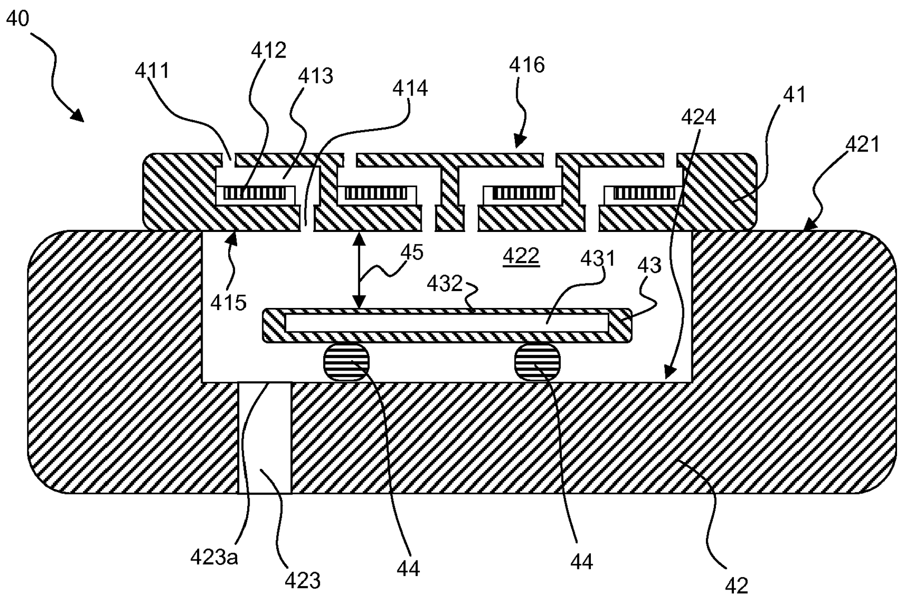

Fig. 1

EP 3 372 407 A1

Description

FIELD OF THE INVENTION

[0001] The present invention generally pertains to an inkjet print head assembly and a method of manufacturing such an inkjet print head.

BACKGROUND ART

[0002] It is known to manufacture an inkjet print head chip using MEMS (Micro ElectroMechanical Systems) technology. Such technology applies, for example, lithographic techniques for providing mechanical structures on a micrometer scale. Use of an actuator, such as a piezo-electric transducer, provides for active systems. Piezo-actuated inkjet print head chips manufactured by this technology are well-known.

[0003] The MEMS-manufactured inkjet print head chips need to be supplied with ink and be handled in a printing assembly. Thereto, it is known to provide the inkjet print head chip on a print head base element allowing to couple the inkjet print head chip to an ink (or any other suitable liquid) supply and to mount the inkjet print head chip in the printing assembly without damaging the fragile inkjet print head chip.

[0004] Fluid dynamics during printing operation may result in pressure waves propagating into ink in an ink supply channel in the print head base element and may even propagate into an ink supply port of neighboring ejection units. Thus, the droplet formation in a neighboring ejection unit may be affected. This phenomenon is well-known and is commonly referred to as cross-talk.

[0005] In order to reduce cross-talk, it is known to provide for a flexible surface in the ink supply channel such that the pressure waves may be damped by the compliancy of the flexible surface.

[0006] For example, in US2015/0375505, discloses a frame for an inkjet print head chip, wherein a damper member is arranged on flanges provided in the frame. The damper member provides a damper film and closes a damper chamber formed in the frame. The damper chamber is an air-filled chamber together with the flexibility of the damper film defining the compliancy of the damper member.

[0007] Further, US2015/0138282 A1 shows an inkjet print head assembly, wherein a closed chamber damper member is mounted onto the MEMS print head chip by means of support legs.

[0008] A disadvantage of these exemplary known assemblies is found in that the frame is a complex and thus expensive element and the resulting compliancy is difficult to control. Further, the accuracies for manufacturing the frame and for manufacturing the damper member are high, with corresponding high costs. Further, the damper member needs to be applied on the flanges in a liquid-tight manner to prevent the liquid to enter the damper chamber, which would remove the damping function of the damper member. Further, a distance between the damper film and the inkjet print head chip is difficult to control, although in high-speed inkjet printing this distance may need to be relatively short and highly accurate in order to achieve the objective of reducing cross-talk.

[0009] It is an object of the present invention to provide for a simple and cost-effective inkjet print head assembly.

SUMMARY OF THE INVENTION

[0010] In an aspect of the present invention, an inkjet print head assembly according to claim 1 is provided.

[0011] The inkjet print head assembly according to the present invention comprises a MEMS-manufactured inkjet chip provided with a number of ejection units, a print head base element and a damper element. Each ejection unit comprises a nozzle for ejecting a droplet of liquid and a liquid supply port for receiving liquid in the ejection unit, wherein the nozzles are arranged in a first chip surface of the inkjet chip and the liquid supply ports are arranged in a second chip surface, the second chip surface being opposite to the first chip surface. The print head base element has a liquid supply recess and the inkjet chip is arranged on the print head base element over the liquid supply recess, wherein the second chip surface faces the liquid supply recess such that the liquid supply ports are in fluid communication with the liquid supply recess. The damper element comprises a closed hollow space and a flexible wall arranged over the closed hollow space and the damper element is mounted on the print head base element and arranged in the liquid supply recess, wherein the flexible wall faces the liquid supply ports arranged in the second chip surface, the flexible wall being arranged at a predetermined damper distance from the second chip surface.

[0012] A relatively simple and cost-effective print head base element is provided with an ink supply recess, which is large enough to encompass the damper element. The damper element is provided with a closed hollow space such that the ink (in general: any suitable liquid to be ejected from the inkjet print head assembly) cannot enter the closed hollow space. The ink may flow around the damper element and into the ink supply ports of the MEMS-manufactured inkjet print head chip.

[0013] In an embodiment of the inkjet print head assembly, the liquid supply recess is provided with a support surface for supporting the damper element and a liquid supply opening for receiving liquid in the liquid supply recess. In particular, the flexible wall of the damper element at least partly forms a first damper surface of the damper element and a second damper surface of the damper element, different from the first damper surface, is adhered on the support surface with an adhesive. More in particular, the adhesive forms a positioning layer having a thickness, wherein the thickness of the positioning layer is selected such that the flexible wall of the damper element is positioned at the predetermined damper distance from the second chip surface. Thus, the adhesive may be used to position the damper element, in particular the flexible wall thereof, at the predetermined distance for achieving good cross-talk damping, while a simple recess may be provided in a cost-effective and simple print head base element, for example made of graphite, or the like. Inaccurate, but cost-effective manufacturing steps may be employed and the resulting inaccuracy may be compensated by selecting a suitable thickness of the positioning layer formed by the adhesive. The applicability of the print head assembly according to the present invention is improved, as the assembly may be relatively easily tuned to a desired ink type or application by selecting the appropriate compliancy of the damper element and/or the selecting an appropriate distance by controlling the thickness of the adhesive. Thereby, the present invention provides a versatile print head assembly applicable to a wide range of different liquid materials. It will be appreciated that the dimensions and materials of the components in the print head assembly according to the present invention may be kept constant, as tuning of the thickness of the adhesive layer and/or tuning the compliancy of the damper element provides sufficient means to make the print head assembly suitable for a specific liquid. Thereby a wide of ranges of print applications may be provided at reduced costs.

[0014] In an embodiment, the damper element is positioned between the second chip surface and the liquid supply opening. When viewed in a height direction perpendicular to the second chip surface, the damper element is positioned at a distance from both the second chip surface and the liquid supply opening. In a cross-sectional side view the damper element is suspended between the back wall with the liquid supply opening formed therein and the second chip surface. The support surface is thus also, as seen in said height direction, positioned between the second chip surface and the liquid supply opening (and/or the back wall). The liquid supply opening is preferably formed by a channel having an opening in the back wall. This provides a simple configuration which allows liquid to flow from the liquid supply opening around the damper element to the liquid supply port(s).

[0015] In another embodiment, the support surface substantially faces the second chip surface. In absence of the damper element the second chip surface and the support surface are opposing surfaces. The second damper surface of the damper element faces the support surface. This allows for easy manufacturing as the support surface may be formed as part of the outer walls defining the liquid supply recess.

[0016] In a further embodiment, the support surface extends substantially parallel to the second chip surface. This allows for accurate positioning of the damper element by controlling the thickness of the adhesive layer. A single adhesive layer thickness can then be applied for each individual print head assembly.

[0017] In an embodiment, the in supply recess comprises a back wall facing the second chip surface and wherein the damper element is positioned between the back wall and the second chip surface at a distance from the back wall. The back wall is preferably the wall of the liquid supply recess spaced furthest from the second chip surface, i.e. the wall at the highest/maximum distance from the second chip surface. The damper element is then positioned inside the ink supply recess, suspended between the back wall and the second chip surface.

[0018] In an embodiment, the damper element is formed by a damper base element having a damper recess and a damper membrane, wherein the membrane is arranged over the damper recess to form the closed hollow space. In particular, the damper element is formed by MEMS-processing. Thus, a damper element may be easily and accurately manufactured. Moreover, a highly accurate compliancy of the damper element may be achieved. Combined with the accurate positioning at the predetermined damper distance, an optimal cross-talk damping may be achieved.

[0019] Note that the accuracy for manufacturing the damper element is directed at the compliancy of the damper element and is not directed at the outer dimensions of the damper element. Like with the inaccuracy for manufacturing the print head base element, any inaccuracy in the outer dimensions of the damper element may be compensated by the positioning in the liquid supply recess.

[0020] In an aspect, the present invention further provides a method for manufacturing an inkjet print head assembly according to the present invention and wherein the method comprises providing a liquid supply recess in a first base surface of the print head base element; providing the damper element in the liquid supply recess, wherein the damper element is positioned such that the flexible wall faces the first base surface and such that the flexible wall is positioned at a predetermined damper distance from the first base surface of the print head base element; and providing the inkjet chip on the first base surface of the print head base element to position the liquid supply ports facing the flexible wall of the damper element.

[0021] In an embodiment, the method further comprises providing an amount of uncured adhesive at a predetermined position in the liquid supply recess prior to providing the damper element in the liquid supply recess and wherein the uncured adhesive has a viscosity; providing the damper element on the uncured adhesive and curing the uncured adhesive to fix the relative position of the damper element. In this embodiment, the viscosity of the uncured adhesive is sufficiently high to maintain the position of the damper element after positioning and before curing and the viscosity of the uncured adhesive is sufficiently low to allow the damper element to be positioned at the predetermined damper distance by application of pressure. Thus, a positioning layer may be formed by the adhesive.

[0022] In an embodiment, the method further comprises, prior to providing the damper element in the liquid supply recess, the steps of determining a compliancy of the flexible wall of the damper element and determining the predetermined damper distance based on the determined compliancy. An optimal damper distance may be dependent on the actual compliancy of the damper element. The method according to the present invention allows applying a damper distance that may vary depending on the compliancy of the damper element. Note that this method also allows to use a common print head base element and a common damper element in combination with a number of varying inkjet print head chips. For example, an ejection unit in an inkjet print head chip may be designed for a liquid with a low viscosity and an ejection unit in another chip may be designed for a liquid with a higher viscosity. In such case, a same print head base element may be employed in combination with any of these two inkjet print head chips. The same applies for the damper element, wherein the predetermined damper distance may be adapted to the different inkjet print head chips and/or the viscosity of the liquid.

[0023] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating embodiments of the invention, are given by way of illustration only, since various changes and modifications within the scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying schematical drawings which are given by way of illustration only, and thus are not limitative of the present invention, and wherein:

- Fig. 1 shows a cross-section of a first exemplary embodiment of an inkjet print head assembly according to the present invention;
- Fig. 2A shows a cross-section of a second exemplary embodiment of an inkjet print head assembly according to the present invention;
- Fig. 2B shows another cross-section of the second exemplary embodiment of Fig. 2A;
- Fig. 3 illustrates a first exemplary embodiment of a method of manufacturing a damper element according to the present invention;
- Fig. 4A - 4B illustrate a second exemplary embodiment of a method of manufacturing a damper element according to the present invention; and
- Fig. 5A - 5E illustrate a method of manufacturing an inkjet print head assembly according to the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

[0025] 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.

[0026] Fig. 1 shows a first embodiment of an inkjet print head assembly 40 comprising a MEMS-manufactured inkjet chip 41 arranged on a print head base element 42. In the inkjet chip 41, a number of ejection units are, each ejection unit comprising a nozzle 411, an actuator 412, a pressure chamber 413 and a liquid supply port 414. The nozzles 411 are arranged in a first chip surface 416, commonly also referred to as a nozzle surface 416, and the liquid supply ports 414 are arranged in a second chip surface 415. The print head base element 42 is provided with an ink supply recess 422, which is formed in a first base surface 421. The inkjet chip 41 is arranged over the ink supply recess 422 on the first base surface 421, wherein the second chip surface 415 faces the ink supply recess 422 such that the ink supply ports 414 are in fluid communication with the ink supply recess 422. The print head base element 42 further comprises a liquid supply channel 423 in fluid communication with the liquid supply recess 422 through a liquid supply opening 423a.

[0027] A damper element 43 is arranged in the liquid supply recess 422. The damper element 43 comprises a closed hollow space 431 and a flexible wall 432. The flexible wall 432 faces the liquid supply ports 414. In this first embodiment, the damper element 43 is arranged on a support surface 424, which corresponds to a bottom surface of the ink supply recess 422. The damper element 43 is supported on the support surface 424 by an adhesive 44 forming a positioning layer for arranging the flexible wall 432 at a predetermined damper distance 45 from the ink supply ports 414.

[0028] In operation, a liquid, such as but not limited to ink, is supplied through the liquid supply channel 423 to the liquid supply recess 422 which is thus filled with the liquid. Since the damper element 43 has a closed hollow space 431, the hollow space 431 remains clear from liquid and is only filled with a gas, such as but not limited to air. The liquid flows from the liquid supply recess 422 into the liquid supply ports 414 and through the pressure chambers 413 to the nozzles 411. As known in the art, with suitable pressure control, it is prevented that the liquid flows out of the nozzles 411 spontaneously, however, upon actuation of the actuator 412, a droplet of the liquid may be expelled through the nozzle 411 associated with said actuator 412.

[0029] For droplet ejection, a pressure wave is generated in the liquid in the pressure chamber 412. Upon actuation, the pressure wave propagates not only through the liquid in the pressure chamber 412, but also through the liquid in the ink supply port 414 and into the liquid in the ink supply recess 422. Through the liquid in the ink supply recess 422, the pressure wave may even propagate into a neighboring liquid supply port 414, thereby affecting pressure generation and droplet formation in the neighboring ejection unit. This cross-talk phenomenon is undesired, since it negatively impacts image formation due to, for example, missing image dots, satellite droplets, and other artifacts. In order to reduce the cross-talk, the damper element 43 is provided to absorb such pressure waves before they reach the neighboring ejection units.

[0030] For sufficient and appropriate damping, a number of acoustic parameters need to be accurately selected and implemented. For example, the compliancy of the damper element 43 and the damper distance 45 need to be accurately determined and implemented. Moreover, these parameters may need to be adapted to each other and maybe dependent on other parameters such as viscosity and/or density of the liquid. Further, the damper distance 45 may need to be very small, for example in a micrometer range, i.e. smaller than one millimeter. Accuracy for good pressure wave damping may thus be in the order of some micrometers, possibly less than 10 micrometers. With a desire to use a cost-effective print head base element 42 from for example graphite and manufactured with the use of conventional machining like e.g. drilling and milling, such accuracy is not achievable. However, using commonly available positioning apparatus, the damper element 43 may be positioned relative to the first base surface 421 in the liquid supply recess 422. It is noted that the position of the first base surface 421 corresponds to the position of the second chip surface 415 and hence may be used to determine the damper distance 45. To maintain that position and in accordance with the present invention, the adhesive 44 is provided on the support surface 424 in a relatively thick layer or dots. The adhesive 44 has, in an uncured state, a relatively high viscosity such that the damper element 43 remains in position as long as no external force is applied. On the other hand, the viscosity of the adhesive 44 is sufficiently low such that the adhesive 44 adapts to the position of the damper element 43 when the damper element 43 is put into position by the positioning apparatus. Then, as soon as the damper element 43 is in position, the adhesive 44 may be cured, for example by use of heat or suitable radiation depending on the kind of adhesive used, such that the adhesive 44 hardens and forms a positioning layer supporting the damper element 43 and keeping it in its position relative to the second chip surface 415.

[0031] As an alternative method for positioning the damper element 43, a mechanical positioning tooling may hold the damper element 43 in its desired position. Prior to that positioning or after that positioning a suitable adhesive may be applied. Then, after positioning, the adhesive may be cured. In this alternative embodiment, the mechanical positioning tool releases the damper element 43 only after curing. This alternative embodiment releases the requirements on the adhesive used, since the viscosity range is not an important requirement.

[0032] Figs. 2A and 2B illustrate an embodiment similar to the embodiment of Fig. 1 except that a support surface 424 is provided protrusions from the bottom surface of the liquid supply recess 422. Smaller amounts of adhesive 44 may thus be applied. In particular, in Fig. 2A a cross-section along a width of the inkjet print head chip 41 is shown. In this cross-sectional view, the damper element 43 is not contacted by any other element and liquid in the liquid supply recess 422 may freely flow around the damper element 43. In Fig. 2B, a cross-section along a length, i.e. perpendicular to the width, of the print head chip 41 is shown. In this cross-sectional view, the damper element 43 is supported on its ends on the support surface 424, which is a top surface of the protrusion. The protrusion may be easily and cost-effectively provided by suitably drilling and milling, and the like manufacturing operations, the liquid supply recess 422 in the first base surface 421 of the print head base element 42.

[0033] Fig. 3 illustrates a first embodiment of a damper element 43, which may be made with MEMS processing techniques, although conventional processes may be applied as well. The damper element 43 comprises a damper base 433 made of a plate material and in which a damper recess 431 is provided. For example, the damper base 433 may be made of graphite and the damper recess 431 may be made by suitable conventional processing techniques such as drilling and milling. In another embodiment, the damper base 433 may be made of silicon and the damper recess 431 may be made by suitable MEMS processing such as lithographic techniques including etching. Separately, a damper membrane 432 is manufactured and is then arranged on the damper base 433, for example by application of an adhesive, as illustrated by arrow P1. It is noted that the membrane 432 may be applied on the damper base 433 as a thick layer and then the thickness of the membrane 432 may be reduced to its desired thickness. Like the damper base 433, the membrane 432 may be made of graphite, silicon or any other suitable material and the processing techniques may be selected in accordance with the material as apparent to those skilled in the art. After attaching the membrane 432 to the damper base 433, the damper recess 431 forms the closed hollow space 431.

[0034] Figs. 4A and 4B illustrate a specific MEMS-processed damper element 43, wherein a SOI (silicon on insulator) wafer is MEMS processed to obtain a highly accurate compliancy. In Fig. 4A, a SOI-wafer comprising a silicon base layer 434, an insulator layer 432b and a second silicon layer 432a is shown. Depending on the desired compliancy and the available thickness of the insulator layer 432b, the second silicon layer 432a could be omitted. Using MEMS processing, like lithographic techniques including etching, wherein the insulator layer 432b is used as an etch-stop layer, a membrane 432 may be formed, wherein the membrane 432 has a very well-defined and uniform thickness. At the same time, a damper recess 431 is formed.

[0035] As shown in Fig. 4B, attaching a suitable base layer 435, in accordance with arrow P2, closes the damper recess 431 to form the closed hollow space 431 and the membrane 432 forms a flexible wall thereof. Thus, a damper element 43 having a very accurate compliancy may be provided.

[0036] Figs. 5A - 5E show in more detail an embodiment of the manufacturing process according to the present invention. In particular, the embodiment of the manufacturing process relates to the embodiment of the inkjet print head assembly according to Figs. 2A and 2B.

[0037] Fig. 5A shows a print head base element 42, which may be made from any suitable material, although a cost-effective and easily processable material is selected. In particular, in view of the MEMS-processed inkjet chip to be positioned on a first base surface 421, the material of the print head base 42 may preferably be selected to be graphite in view of the small difference in thermal expansion coefficient, for example. As illustrated in Fig. 5B, a first processing step includes forming a liquid supply recess 422 in the first base surface 421 of the print head base element 42. Further, other structures, such as an ink supply channel (not shown in Fig. 5A - 5E) for example, may be provided. The liquid supply recess 422 may be provided with support surfaces 424, for example on protrusions from a bottom surface of the liquid supply recess 422.

[0038] In Fig. 5C, an amount of uncured adhesive 44-u has been provided on the support surface 424, wherein the amount is selected such that the thickness of the amount is larger than a thickness needed to support the damper element 43 at a desired position. The damper element 43 is then positioned in the liquid supply recess 422 by moving the damper element 43 into place in the direction of arrow P3 and onto the uncured adhesive 44-u.

[0039] As illustrated in Fig. 5D, using the first base surface 421 as a reference surface, the damper element 43 may be pushed into the uncured adhesive 44-u until the damper element 43 is in the desired position at the damper distance 45 from the first base surface 421. Due to the viscosity of the uncured adhesive 44-u, the damper element 43 remains in this position, provided no other external forces are applied. The adhesive is then cured to form cured adhesive 44-c, forming a positioning layer for the damper element 43.

[0040] In a last step illustrated in Fig. 5E, the MEMS-manufactured inkjet chip 41 is arranged on the first base surface 421 over the liquid supply recess 422.

[0041] In the illustrated process, the damper distance 45 is determined by the positioning of the damper element 43. Using a suitable adhesive, the damper distance 45 may be varied irrespective of the shape and depth of the liquid supply recess 422 and the position of the support surface 424. Therefore, for example, before positioning the damper element 43, the damper distance 45 may be determined dependent on properties of the particular inkjet chip 41 to be arranged on that particular print head base element 42. Similarly, a property of the liquid to be ejected may be taken into account. Further, a damper property, e.g. compliancy, may be taken in to account for determining a particular damper distance for a particular damper element and inkjet chip combination.

[0042] Detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. In particular, features presented and described in separate dependent claims may be applied in combination and any advantageous combination of such claims is herewith disclosed.

[0043] Further, it is contemplated that structural elements may be generated by application of three-dimensional (3D) printing techniques. Therefore, any reference to a structural element is intended to encompass any computer executable instructions that instruct a computer to generate such a structural element by three-dimensional printing techniques or similar computer controlled manufacturing techniques. Furthermore, such a reference to a structural element encompasses a computer readable medium carrying such computer executable instructions.

[0044] Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention. The terms "a" or "an", as used herein, are defined as one or more than one. The term plurality, as used herein, is defined as two or more than two. The term another, as used herein, is defined as at least a second or more. The terms including and/or having, as used herein, are defined as comprising (i.e., open language). The term coupled, as used herein, is defined as connected, although not necessarily directly.

[0045] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

Claims

1. An inkjet print head assembly (40), the inkjet print head assembly comprising

    • a MEMS-manufactured inkjet chip (41) provided with a number of ejection units, each ejection unit comprising a nozzle (411) for ejecting a droplet of liquid and a liquid supply port (414) for receiving liquid in the ejection unit, wherein the nozzles are arranged in a first chip surface (416) of the inkjet chip and the liquid supply ports are arranged in a second chip surface (415), the second chip surface being opposite to the first chip surface;

- a print head base element (42) having a liquid supply recess (422), the inkjet chip being arranged on the print head base element over the liquid supply recess, the second chip surface facing the liquid supply recess such that the liquid supply ports are in fluid communication with the liquid supply recess; and
- a damper element (43), the damper element comprising a closed hollow space (431) and a flexible wall (432) arranged over the closed hollow space, **characterized by** the damper element being mounted on the print head base element and being arranged in the liquid supply recess, wherein the flexible wall faces the liquid supply ports arranged in the second chip surface, the flexible wall being arranged at a predetermined damper distance (45) from the second chip surface.

2. The inkjet print head assembly according to claim 1, wherein the liquid supply recess is provided with a support surface (424) for supporting the damper element and a liquid supply opening (423a) for receiving liquid from a liquid supply channel (423).

3. The inkjet print head assembly according to claim 2, wherein the damper element is positioned between the second chip surface and the liquid supply opening.

4. The inkjet print head assembly according to claim 2 or 3, wherein the support surface substantially faces the second chip surface.

5. The inkjet print head assembly according to any of the claims 2 to 4, wherein the support surface extends substantially parallel to the second chip surface.

6. The inkjet print head assembly according to any of the previous claims, wherein the in supply recess comprises a back wall facing the second chip surface and wherein the damper element is positioned between the back wall and the second chip surface at a distance from the back wall.

7. The inkjet print head assembly according to any of the claims 2 to 6, wherein the flexible wall at least partly forms a first damper surface of the damper element and wherein a second damper surface of the damper element, different from the first damper surface, is adhered on the support surface with an adhesive.

8. The inkjet print head assembly according to claim 7, wherein the first and second damper surfaces are facing in substantially opposite directions.

9. The inkjet print head assembly according to claim 7 or 8, wherein the adhesive forms a positioning layer having a thickness, wherein the thickness of the positioning layer is selected such that the flexible wall of the damper element is positioned at a predetermined damper distance from the second chip surface.

10. The inkjet print head assembly according to any of the previous claims, wherein the damper element is formed by a damper base element having a damper recess and a damper membrane, wherein the membrane is arranged over the damper recess to form the closed hollow space.

11. The inkjet print head assembly according to claims 10, wherein the damper element is formed by MEMS-processing.

12. A damper element for use in an inkjet print head assembly according to any one of the previous claims, wherein the damper element comprises

- a damper base element having a damper recess; and
- a damper membrane; and

wherein the damper membrane is arranged over the damper recess to form the closed hollow space.

13. A method for manufacturing an inkjet print head, wherein the inkjet print head comprises a MEMS-manufactured inkjet chip, a print head base element and a damper element,
wherein the inkjet chip is provided with a number of ejection units, each ejection unit comprising a nozzle for ejecting a droplet of liquid and a liquid supply port for receiving liquid in the ejection unit, wherein the nozzles are arranged in a first chip surface of the inkjet chip and the liquid supply ports are arranged in a second chip surface, the second chip surface being opposite to the first chip surface;
wherein the damper element comprises a closed hollow space and a flexible wall arranged over the closed hollow space, and
wherein the method comprises:

- providing a liquid supply recess in a first base surface (421) of the print head base element;
- providing the damper element on the print head base element in the liquid supply recess, where-

in the damper element is positioned such that

- ◦ the flexible wall faces the first base surface; and
- ◦ the flexible wall is positioned at a predetermined damper distance from the first base surface of the print head base element; and

• providing the inkjet chip on the first base surface of the print head base element to position the liquid supply ports facing the flexible wall of the damper element.

14. The method according to claim 13, further comprising the steps of:

- • providing uncured adhesive at a predetermined position in the liquid supply recess;
- • providing the damper element on the uncured adhesive,
- • curing the uncured adhesive to fix the relative position of the damper element;

wherein the uncured adhesive maintains the position of the damper element after positioning and before curing; and
wherein the uncured adhesive allows the damper element to be positioned at the predetermined damper distance by application of pressure.

15. The method according to claim 14, wherein the method further comprises, prior to providing the damper element on the uncured adhesive,

- • determining a compliancy of the flexible wall of the damper element; and
- • determining the predetermined damper distance based on the determined compliancy.

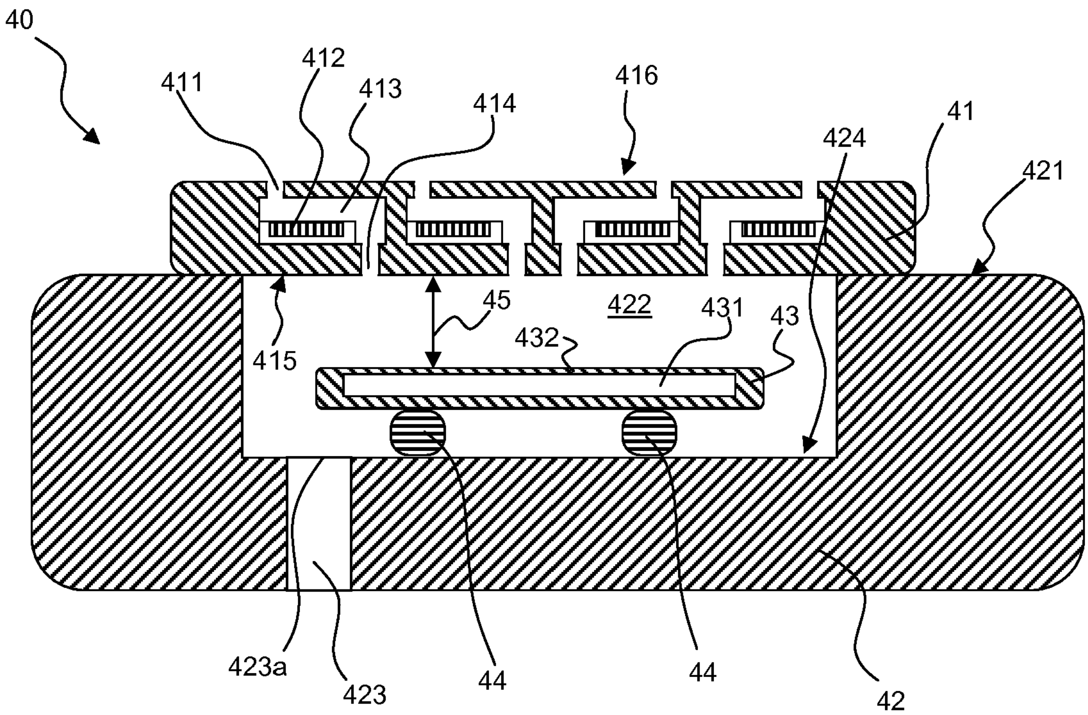
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Fig. 1

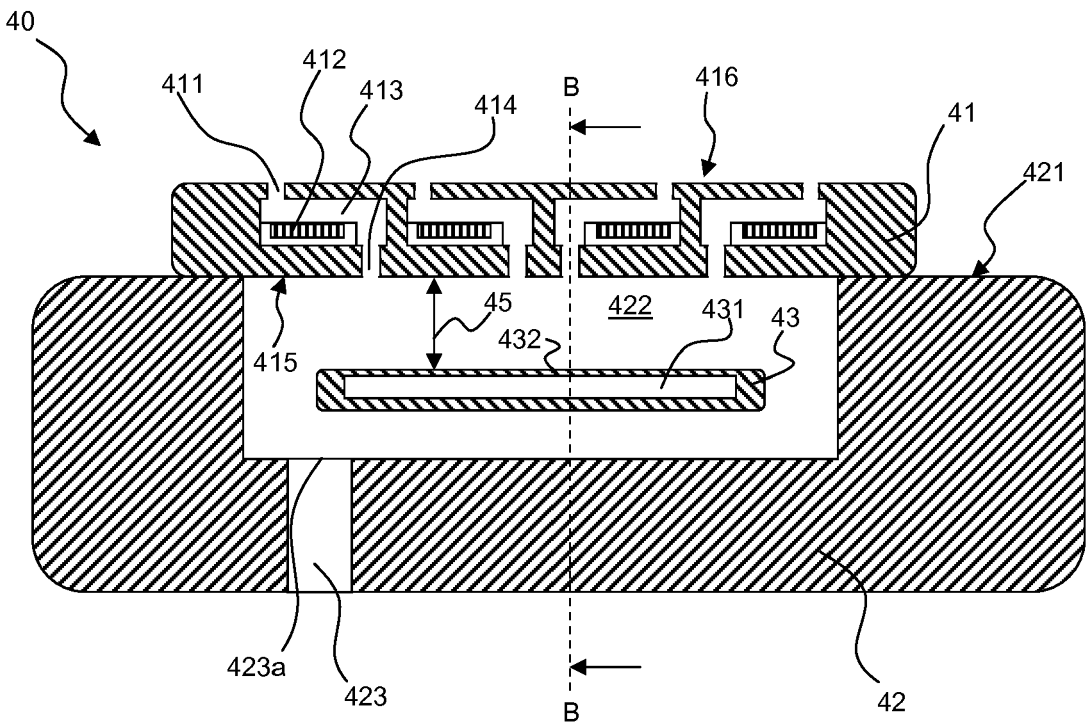
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Fig. 2A

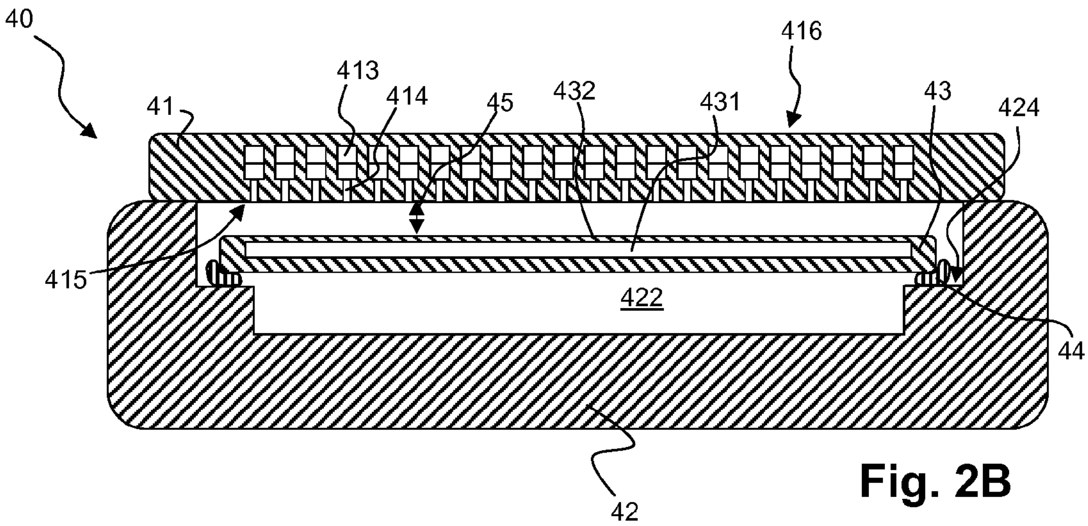

Fig. 2B

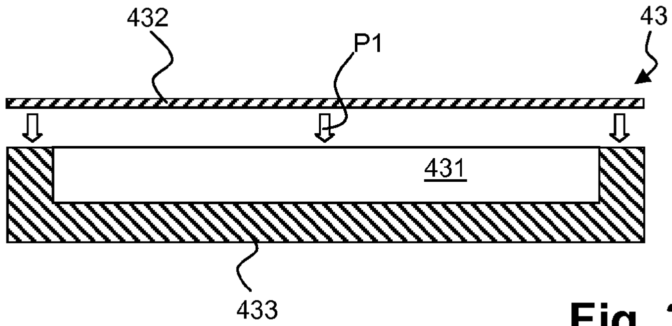

Fig. 3

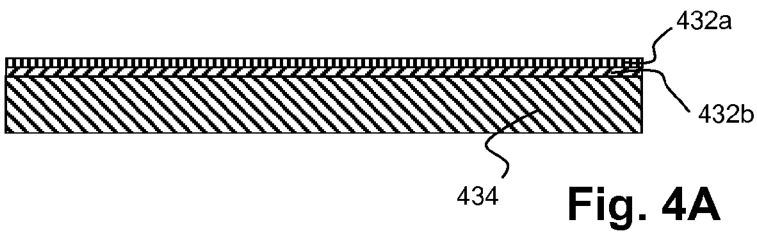

Fig. 4A

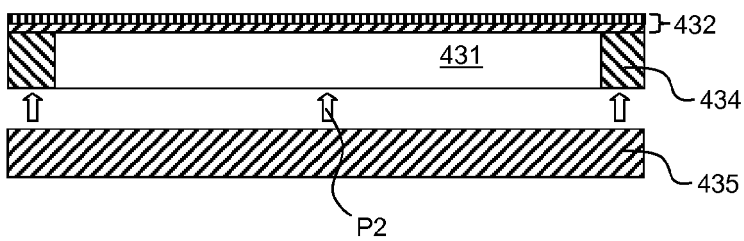

Fig. 4B

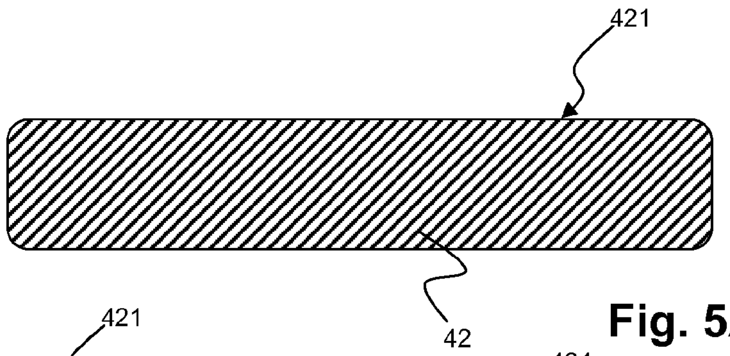

Fig. 5A

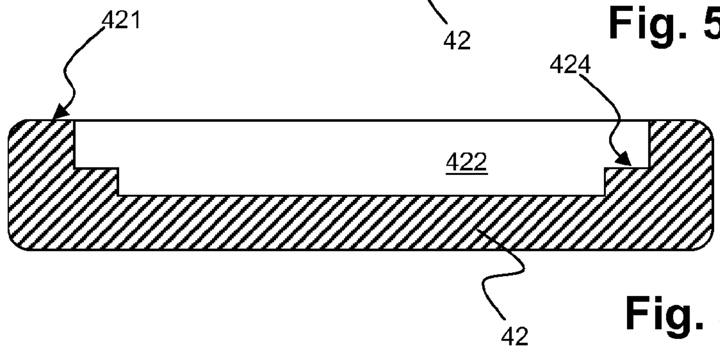

Fig. 5B

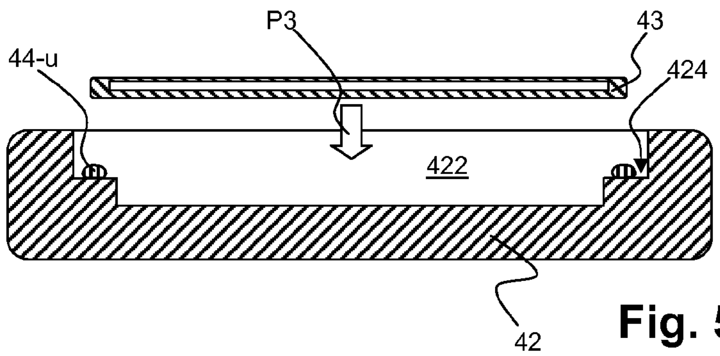

Fig. 5C

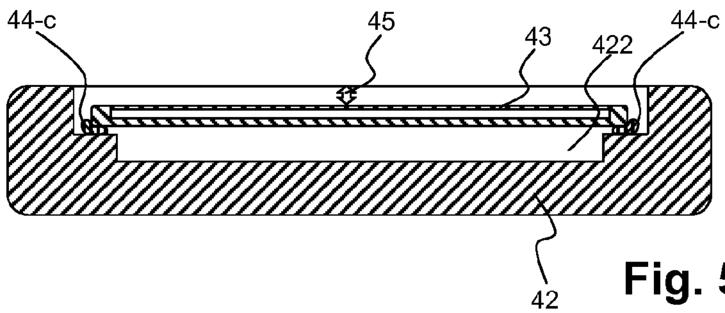

Fig. 5D

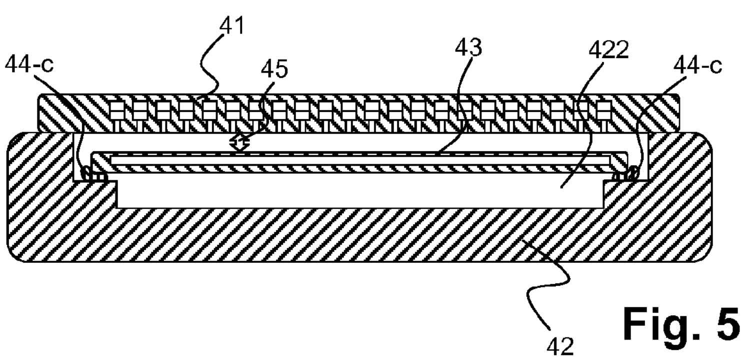

Fig. 5E

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EUROPEAN SEARCH REPORT

Application Number
EP 18 15 9358

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 2015/138282 A1 (KOBAYASHI RYOHEI [JP] ET AL) 21 May 2015 (2015-05-21) * paragraphs [0067], [0191], [0144], [0151], [0079], [0057], [0026], [0027]; figures 2,6 *	1-15	INV. B41J2/055 B41J2/14 B41J2/16
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A	JP 2007 118312 A (BROTHER IND LTD) 17 May 2007 (2007-05-17) * figures 2-7 *	1-15	
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The present search report has been drawn up for all claims

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Place of search	Date of completion of the search	Examiner
The Hague	20 July 2018	Tzianetopoulou, T

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