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(54) **DROP EJECTION ASSEMBLY**

TROPFENAUSSTOSSANORDNUNG

DISPOSITIF D'EJECTION DE GOUTTES

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Description

TECHNICAL FIELD

[0001] This invention relates to depositing drops on a substrate.

BACKGROUND

[0002] Ink jet printers are one type of apparatus for depositing drops on a substrate. Ink jet printers typically include an ink path from an ink supply to a nozzle path. The nozzle path terminates in a nozzle opening from which ink drops are ejected. Ink drop ejection is typically controlled by pressurizing ink in the ink path with an actuator, which may be, for example, a piezoelectric deflector, a thermal bubble jet generator, or an electrostatically deflected element. A typical print assembly has an array of ink paths with corresponding nozzle openings and associated actuators. Drop ejection from each nozzle opening can be independently controlled. In a drop-on-demand print assembly, each actuator is fired to selectively eject a drop at a specific pixel location of an image as the print assembly and a printing substrate are moved relative to one another. In high performance print assemblies, the nozzle openings typically have a diameter of 50 microns or less, e.g. around 25 microns, are separated at a pitch of 100-300 nozzles/inch, have a resolution of 100 to 3000 dpi or more, and provide drops with a volume of about 1 to 120 picoliters (pl) or less. Drop ejection frequency is typically 10 kHz or more.

[0003] Hoisington et al. U.S. Patent No. 5,265,315, describes a print assembly that has a semiconductor body and a piezoelectric actuator. The body is made of silicon, which is etched to define ink chambers. Nozzle openings are defined by a separate nozzle plate, which is attached to the silicon body. The piezoelectric actuator has a layer of piezoelectric material, which changes geometry, or bends, in response to an applied voltage. The bending of the piezoelectric layer pressurizes ink in a pumping chamber located along the ink path. Piezoelectric ink jet print assemblies are also described in Fishbeck et al. U.S. Patent No. 4,825,227, Hine U.S. Patent No. 4,937,598, Moynihan et al. U.S. Patent No. 5,659,346 and Hoisington U.S. Patent No. 5,757,391.

[0004] EP 1 293 343 discloses a liquid discharge recording head comprising a substrate on which an energy generating element for generating liquid discharging energy is provided, and an orifice plate which is laminated with the substrate and in which a discharge port corresponding to the energy generating element is provided, and wherein a liquid droplet is discharged in a direction substantially perpendicular to surfaces of the substrate and the orifice plate, and further wherein a flow path is formed between the substrate and the orifice plate, a groove encircling the flow path is formed in the orifice plate, and edge portions of the orifice plate contacted with the groove are formed as saw-shaped portions having a number of minute indentations.

[0005] EP 0 943 441 discloses an ink jet recording head, wherein an open exhaust port is secured on the side of the end in a direction in which a cleaning blade and a recording head are relatively moved in the vicinity of a nozzle aperture in a nozzle plate and a protective layer for regulating so that the cleaning blade comes in contact with the vicinity of a nozzle aperture when the cleaning blade is pressed is formed.

[0006] EP 0 960 733 discloses an ink jet head, including a plurality of discharging outlets disposed in an arrangement direction; a plurality of ink pathways communicating with an associated one of said discharging outlets, each ink pathway having an energy generating element for generating energy for discharging an ink from said discharging outlet; and a discharging outlet face having a discharging outlet surface, said discharging outlets being arranged in said discharging outlet surface and a water-repellent discharging outlet peripheral region circumscribing said discharging outlets, and having a first side and a second side, herewith a recessed hydrophilic region circumscribing said water-repellent discharging outlet peripheral region, said recessed hydrophilic region being positioned along the arrangement direction of the discharging outlets on at least one said side of said water-repellent discharging outlet peripheral region, said recessed hydrophilic region being separated by a predetermined distance from said water-repellent discharging outlet peripheral region.

SUMMARY

[0007] In an aspect, the invention features a drop ejector according to claim 1.

[0008] In another aspect, the invention features a drop ejector according to claim.

[0009] Other aspects or embodiments are defined in claims 2-12 and 14-25.

[0010] Embodiments may include one or more of the following advantages. Printhead operation is robust and reliable since waste ink about the face of the nozzle plate is controlled to reduce interference with drop formation and ejection. Drop velocity and trajectory straightness is maintained in high performance printheads in which large arrays of small nozzles must accurately eject ink to precise locations on a substrate. The projections control waste ink and permit desirable jetting characteristics with a variety of jetting fluids, such as inks with varying viscosity or surface tension characteristics, and heads with varying pressure characteristics at the nozzle openings. The projections are robust, do not require moving components, and can be economically implemented by etching, e.g., in a semiconductor material such as a silicon material.

[0011] Still further aspects, features, and advantages follow. For example, particular aspects include projection dimensions, characteristics, and operating conditions described below.

DESCRIPTION OF DRAWINGS

[0012]

Fig. 1 is a schematic of a drop ejection assembly.
Fig. 2 is a perspective view of a portion of a nozzle plate with projections.
Fig. 3 is a top view of a portion of a nozzle plate with projections.
Fig. 4 is a perspective view of a portion of a nozzle plate with a nozzle opening and projections disposed in a well.
Fig. 5 is a perspective view of a portion of a nozzle plate with arcuate projections.
Fig. 5A is a top view of a portion of the nozzle plate shown in Fig. 5.
Fig. 5B is a cross-sectional view of the nozzle plate portion shown in Fig. 5A, taken along line 5B-5B.

DETAILED DESCRIPTION

[0013] Referring to Fig. 1, an inkjet apparatus 10 includes a reservoir 11 containing a supply of ink 12 and a passage 13 leading from the reservoir 11 to a pressure chamber 14. An actuator 15, e.g., a piezoelectric transducer, forms one wall of the pressure chamber 14. The actuator is operable to force ink from the pressure chamber 14 through a passage 16 leading to a nozzle opening 17 in an nozzle plate 18, causing a drop of ink 19 to be ejected from the nozzle 17 toward a substrate 20. During operation, the ink j et apparatus 10 and the substrate 20 can be moved relative to one another. For example, the substrate can be a continuous web that is moved between rolls 22 and 23. By selective ejection of drops from an array of nozzles 17 in nozzle plate 18, a desired image is produced on substrate 20.

[0014] The inkjet apparatus also controls the operating pressure at the ink meniscus proximate the nozzle openings when the system is not ejecting drops. Variations in meniscus pressure can cause variation in drop volume or velocity which can lead to printing errors and weeping. In the embodiment illustrated, pressure control is provided by a vacuum source 30 such as a mechanical pump that applies a vacuum to the headspace 9 over the ink 12 in the reservoir 11. The vacuum is communicated through the ink to the nozzle opening 17 to prevent ink from weeping through the nozzle opening by force of gravity. A controller 32, e.g. a computer controller, monitors the vacuum over the ink in the reservoir 11 and adjusts the source 30 to maintain a desired vacuum in the reservoir. In other embodiments, a vacuum source is provided by arranging the ink reservoir below the nozzle openings to create a vacuum proximate the nozzle openings. An ink level monitor (not shown) detects the level of ink, which falls as ink is consumed during a printing operation and thus increases the vacuum at the nozzles. A controller monitors the ink level and refills the reservoir from a bulk container when ink falls below a desired level to maintain vacuum within a desired operation range. In other embodiments, in which the reservoir is located far enough below the nozzles that the vacuum of the meniscus overcomes the capillary force in the nozzle, the ink can be pressurized to maintain a meniscus proximate the nozzle openings. In embodiments, the operating vacuum is maintained at about 0.5 to about 10 inches of water.

[0015] Referring to Fig. 2, nozzle plate portion 90 includes elevated platform 92 and nozzle opening 94 that is centered on platform 92. Proximate the platform 92 and nozzle opening 94 is a field of ink control projections 96 in the form of cylindrical posts that extend from the floor of the nozzle plate transversely to the plane of nozzle opening 94. During ink jetting, ink may collect on the nozzle plate 18. If ink collection is uncontrolled, over time, the ink can form puddles which cause printing errors. For example, puddles near the edge of a nozzle opening can affect the trajectory, velocity or volume of the ejected drops. Also, a puddle could become large enough so that it drips onto printing substrate causing an extraneous mark. The puddle could also protrude far enough off the nozzle plate surfaces that the printing substrate comes into contact with it, causing a smear on the printing substrate. The projections 96 spread waste fluid about the nozzle plate and, thus, discourage the growth of deep puddles that can, e.g., drip off the nozzle plate onto printing substrate. Initially, puddles form on platform 92 and then move from platform 92 to the field of projections 96 that are proximate platform 92. The projections 96 define spaces 98 so that waste fluid is wicked away from nozzle opening 94 by capillary forces.

[0016] Referring to Fig. 3, two portions 90, 90' of a nozzle plate include two adjacent nozzle openings 94, 94' as illustrated. Each of the portions 90, 90' includes a field of projections surrounding the nozzle opening. The fields are bordered by void regions 114, 115 and 117 and waste channels 119, 122. Channels 119, 122 include drain apertures 121. The pattern of the projections diverts ink away from the nozzles and toward the channels. When the nozzle plate is oriented horizontally (nozzle opening upward or downward), waste ink puddles initially move in all possible directions from projection-to-projection under the influence of capillary action, including the four general directions 112, 116, 118 and 120. Once waste ink reaches void region 114, 115 or 117, movement of waste ink is retarded in that direction since the spacing between projections 96 is too great for capillary forces to continue to move waste ink in that direction. The movement of waste ink continues until encountering channels 119,122, which catch waste ink. In embodiments, apertures 121 are maintained under reduced pressure, e.g., by communication with a mechanical vacuum apparatus (not shown) to draw the waste ink from each channel. Alternatively, the apertures can be filled with a wicking material, e.g., a foamed polyurethane or other absorbent material, to remove waste ink from each channel 119. In embodiments, the ratio of the projection height to projection width is from about 0.2 to about 1 or greater, e.g. about 5 or greater. When the nozzle plate is oriented vertically, waste ink moves from projection-to-projection under the influence of gravity and capillary action, macroscopically in a single direction 112, 116, 118 or 120, depending upon the orientation of nozzle plate 110. Suitable channels are described in U.S. Serial Number 10/749,833, filed December 30, 2003, and suitable apertures are described in U.S. Serial Number 10/749,829, filed December 30, 2003.

[0017] The spacing, size, location, shape, number and pattern of the projections are selected to prevent excessive pooling of ink on the nozzle surface by increasing the surface area of the nozzle plate in the area about the nozzle opening. The size of the spaces G between the projections is such that the fluid will be drawn into the openings and retained by capillary forces. In embodiments, the spacing G is between about 20 % of the nozzle opening width W_N or more and about twice the nozzle opening width W_N or less. In embodiments, the pattern of projections define a series of rows and columns. In embodiments, the pattern defines an arc. The pattern of projections can be arranged to direct waste ink in a desired direction on the nozzle plate.

[0018] The width of the projections W_P is small enough to provide substantial increase in surface area, but large enough to be sufficiently robust. In addition, the width of the projections is not so large that excessive waste ink builds up on outer surfaces. In embodiments, the width of the projections is about twice the nozzle opening width or less. The height of the projections H_P can be greater than, equal to, or less than the plane of the nozzle opening. Longer projections can retain a greater amount of waste ink because they present greater surface area. Projections that are recessed below the nozzle opening plane are less susceptible to damage. Projections that are in the plane of the nozzle opening can, in some cases, be easier to manufacture, e.g., by etching.

[0019] The projections are disposed in locations on the nozzle plate in which waste ink may collect. In embodiments, the projections substantially surround the nozzle opening. In embodiments, the projections are spaced from the nozzle opening to discourage the collection of waste ink too close to the nozzle opening, where it could affect drop ejection. In embodiments, the projections are no closer to the periphery of the nozzle opening than about 20% or 200 % of the nozzle opening width W_N.

[0020] In embodiments, the shape of the projections can be elongated posts. The posts can be, e.g., circular in cross-section or irregular in cross-section. The posts can be substantially perpendicular to the plane of the nozzle opening or at other transverse angles with respect to the plane of the nozzle opening. In other embodiments, the projections are wall structures. The wall structures can be attached to the nozzle plate over a substantial area and, thus, resist dislodgement should the nozzle plate come into contact with a foreign body, e.g., a substrate.

[0021] The number of posts is selected to control a desired jetting fluid volume or to create a desired pattern, as discussed above. In embodiments in which the projections surround the nozzle opening, there are four or more posts, e.g., six or more.

[0022] In particular embodiments, the height H_P of the projections is, e.g., from about 5 microns to about 100 microns or more, for example, 200 microns. The spacing S from the closest post to the edge of platform is, e.g., from about 10 microns to about 20 microns, while the gap, G, between the projections is, e.g., about 5 microns to about 25 microns. The width of the projections Wp is, e.g., from about 5 microns to about 20 microns. In embodiments, the nozzle width is about 200 microns or less, e.g., 10 to 50 microns, the nozzle pitch is about 25 nozzles/inch or more, e.g., about 100-300 nozzles/inch, the ink drop volume is about 1 to 70 pL and the fluid is pressurized by a piezoelectric actuator. In embodiments, the jetting fluid has a viscosity of about 1 to 40 centipoise. In embodiments, the the fluid has a surface tension of about 20-50 dynes/cm. In embodiments, the jetting fluid is ink. In embodiments, the jetting fluid is a biological fluid.

[0023] Referring now to Fig. 4, nozzle plate portion 120 includes a nozzle opening 126 disposed in a well 124 and is surrounded by projections 125 in the form of cylindrical posts proximate nozzle opening 126. Projections 125 to symmetrically spread waste ink within the well. Over time, well 124 partially fills with jetting fluid to form a meniscus over the nozzle opening. The use of a well to facilitate the jetting of fluids is described in an application entitled "DROP EJECTION ASSEMBLY" filed concurrently herewith and assigned U.S. Serial Number 10/749,622 filed December 30, 2003.

[0024] Referring to Figs. 5-5B, nozzle plate portion 200 includes a plurality of arcuate projections 202 in the form of walls that form broken, concentric surfaces about elevated platform 204 and nozzle opening 206 that is centered on platform 204. The projections 202 about the elevated platform 204 extend transversely to the plane of the nozzle opening 206. A first space 207 is formed between the edge of the elevated platform 203 and the first series of arcuate projections 202 that form the first broken concentric surface about the elevated platform. A second space 210 is formed between projections 202 that are radially equidistant from the center of the nozzle opening 206 and a third space 212 is formed between projections 202 on adjacent, broken concentric surfaces. Ink puddles that form on platform 204 move to the field of projections 202. The ink wicks into the first space 207 and then moves under capillary action until it finds a second space 210, and then begins to move radially away from the platform 204. Upon encountering a third space 212, the waste ink moves into that space or continues to move radially away from nozzle opening 206. The path followed by the waste ink depends upon the relative sizes of the first 207, second 210 and third 212 spaces. In embodiments, the number of broken, concentric surfaces about platform 204 is, e.g., 2, 4, 6, 10 or more. The spacing between projections is such that fluid will be drawn into the openings and retained by capillary forces as described above. In implementations, the arcuate projections are above the plane of nozzle opening 206.

[0025] The projections and/or the nozzle opening in any of the above described embodiments can be formed by machining, electroforming, laser ablation, and chemical or plasma etching. The projections can also be formed by molding, e.g., injection molded plastic projections. The projections and nozzle opening can be formed in a common body or in separate bodies that are assembled. For example, the nozzle opening can be formed in a body that defines other components of an ink flow path and the well can be formed in a separate body which is assembled to the body defining the nozzle opening. In other embodiments, the projections, nozzle opening, and pressure chamber are formed in a common body. The body can be a metal, carbon or an etchable material such as silicon material, e.g., silicon or silicon dioxide. Forming printhead components using etching techniques is further described in U.S. Serial Number 10/189,947, filed July 3, 2002, and U.S. Serial Number 60/510,459, filed October 10, 2003.

[0026] In embodiments, the drop ejection system can be utilized to eject fluids other than ink. The deposited droplets can be ink or other materials. For example, the deposited droplets may be a UV or other radiation curable material or other material, for example, biological fluids, capable of being delivered as droplets. For example, the apparatus described could be part of a precision dispensing system. The projections can be formed of a porous material, e.g., porous silicon or porous metal, to increase the surface area and, thus, the waste ink handling capacity of the projections. The projections can be formed of an absorbent material that can help to wick away the waste ink from the nozzle plate.

[0027] The projections can be used in combination with other waste fluid control features such as apertures described in U.S. Serial Number 10/749,829 filed December 30, 2003, wells as described in U.S. Serial Number 10/749,622 filed December 30, 2003 and/or channels as described in U.S. Serial Number 10/749,833 filed December 30,2003. For example, a series of channels can be included on the nozzle face proximate the projections. The cleaning structures can be combined with a manual or automatic washing and wiping system in which a cleaning fluid is applied to the nozzle plate and wiped clean. The cleaning structures can collect cleaning fluid and debris rather than jetted waste ink.

[0028] Still other embodiments are within the scope of the following claims.

Claims

1. A drop ejector, comprising:

   a flow path in which fluid is pressurized to eject drops from a nozzle opening (17; 94; 126; 206) in a plane, and
   proximate the nozzle opening (17; 94; 126; 206), a plurality of projections (96; 125; 202) extending transversely to a plane of the nozzle opening (17; 94; 126; 206), wherein the height of the projections (96; 125; 202) is substantially equal to the plane of the nozzle opening (17; 94; 126; 206), and **characterized in that**
   the projections (96; 125; 202) are spaced from each other by spaces (98; 124; 207, 210, 212), and each space (98; 124; 207, 210, 212) is in communication with apertures (121) maintained under reduced pressure.

2. The drop ejector of claim 1 wherein the nozzle opening (17; 94; 126; 206) is surrounded by the projections (96; 125; 202).

3. The drop ejector of claim 1 wherein the projections (96; 125; 202) comprise posts.

4. The drop ejector of claim 1 wherein the projections (96; 125; 202) are wall-shaped.

5. The drop ejector of claim 1 wherein the projections (96; 125; 202) are arranged in a pattern.

6. The drop ejector of claim 5 wherein the pattern defines an array of rows and columns.

7. The drop ejector of claim 5 wherein the pattern defines an arc.

8. The drop ejector of claim 5, wherein the pattern defines concentric ink-collection spaces.

9. The drop ejector of claim 1 wherein the projections (96; 125; 202) have a width that is about twice the nozzle opening width or less.

10. The drop ejector of claim 1 further comprising the nozzle opening (17; 94; 126; 206) having a perimeter and a nozzle opening width, wherein the projections (96; 125; 202) are no closer to the perimeter of the nozzle opening (17; 94; 126; 206) than about 20% of the nozzle opening width.

11. The drop ejector of claim 1 wherein the spacing between projections (96; 125; 202) is about twice the nozzle width or less.

12. The drop ejector of claim 1 wherein the number of the projections (96; 125; 202) is four or greater.

13. A drop ejector, comprising:

   a flow path in which fluid is pressurized to eject drops from a nozzle opening (17; 94; 126; 206) in a plane, and

proximate the nozzle opening (17; 94; 126; 206), a plurality of projections (96; 125; 202) extending transversely to the plane of the nozzle opening (17; 94; 126; 206), wherein the height of the projections (96; 125; 202) is below the plane of nozzle opening (17; 94; 126; 206), and wherein the projections (96; 125; 202) are spaced from each other by spaces (98; 124; 207, 210, 212) and each space (98; 124; 207, 210, 212) is in communication with apertures (121) maintained under reduced pressure.

14. The drop ejector of claim 12 or claim 1 wherein the nozzle opening (17; 94; 126; 206) and projections (96; 125; 202) are defined in a common body.

15. The drop ejector of claim 14 wherein the body comprises a silicon material.

16. The drop ejector of claim 1 or claim 12 including a channel proximate the projections (96; 125; 202), the channel including the apertures (121).

17. The drop ejector of claim 1 or claim 12 including a vacuum source or wicking material proximate the projections (96; 125; 202).

18. The drop ejector of claim 12 wherein the nozzle opening (17; 94; 126; 206) is disposed in a well and the well includes said projections (96; 125; 202).

19. The drop ejector of claim 12 wherein the nozzle opening (17; 94; 126; 206) is disposed on a platform and the projections (96; 125; 202) are disposed proximate the platform.

20. The drop ejector of claim 1 or claim 12 wherein the nozzle opening width is about 200 micron or less.

21. The drop ejector of claim claim 1 or 12 including a piezoelectric actuator.

22. The drop ejector of claim 12 wherein the spacing between said projections (96; 125; 202) is between about 20% of the nozzle opening width or greater and twice the nozzle opening width or less.

23. The drop ejector of claim 1 wherein the projections (96; 125; 202) have a width that is about twice the nozzle opening or less.

24. The drop ejector of claim 12 wherein the projections (96; 125; 202) are arranged in a pattern.

25. The drop ejector of claim 8, wherein the concentric spaces are arranged such that ink can move from one space to another space.

Patentansprüche

1. Tropfenausstoßanordnung, aufweisend:

einen Flußpfad, in dem Fluid unter Druck gesetzt wird, um Tropfen auszustoßen aus einer Düsenöffnung (17; 94; 126; 206) in einer Ebene, und in der Nähe der Düsenöffnung (17; 94; 126; 206), eine Mehrzahl von Vorsprüngen (96; 125; 202), die sich transversal zu einer Ebene der Düsenöffnung (17; 94; 126; 206) erstrecken, worin die Höhe der Vorsprünge (96; 125; 202) im Wesentlichen gleich der Ebene der Düsenöffnung (17; 94; 126; 206) ist, und

dadurch gekennzeichnet, dass

die Vorsprünge (96; 125; 202) voneinander beabstandet sind durch Räume (98; 124; 207, 210, 212), und jeder Raum (98; 124; 207, 210, 212) in Kommunikation mit Öffnungen (121) steht, die unter vermindertem Druck gehalten werden.

2. Tropfenausstoßanordnung nach Anspruch 1, worin die Düsenöffnung (17; 94; 126; 206) von den Vorsprüngen (96; 125; 202) umgeben ist.

3. Tropfenausstoßanordnung nach Anspruch 1, worin die Vorsprünge (96; 125; 202) Pfosten umfassen.

4. Tropfenausstoßanordnung nach Anspruch 1, worin die Vorsprünge (96; 125; 202) wandförmig sind.

5. Tropfenausstoßanordnung nach Anspruch 1, worin die Vorsprünge (96; 125; 202) in einem Muster angeordnet sind.

6. Tropfenausstoßanordnung nach Anspruch 5, worin das Muster eine Matrix aus Reihen und Spalten definiert.

7. Tropfenausstoßanordnung nach Anspruch 5, worin das Muster einen Bogen definiert.

8. Tropfenausstoßanordnung nach Anspruch 5, worin das Muster konzentrische Tintensammelräume definiert.

9. Tropfenausstoßanordnung nach Anspruch 1, worin die Vorsprünge (96; 125; 202) eine Breite aufweisen, die etwa das Doppelte oder weniger als die Breite der Düsenöffnung ist.

10. Tropfenausstoßanordnung nach Anspruch 1, ferner aufweisend die Düsenöffnung (17; 94; 126; 206), die einen Perimeter und eine Düsenöffnungsbreite aufweist, worin die Vorsprünge (96; 125; 202) dem Perimeter der Düsenöffnung (17; 94; 126; 206) nicht näher sind als etwa 20% der Düsenöffnungsbreite.

11. Tropfenausstoßanordnung nach Anspruch 1, worin der Abstand zwischen den Vorsprüngen (96; 125; 202) etwa das Doppelte oder weniger der Düsenöffnungsbreite ist.

12. Tropfenausstoßanordnung nach Anspruch 1, worin die Anzahl der Vorsprünge (96; 125; 202) vier oder mehr ist.

13. Tropfenausstoßanordnung, aufweisend:

einen Flußpfad, in dem Fluid unter Druck gesetzt wird, um Tropfen auszustoßen aus einer Düsenöffnung (17; 94; 126; 206) in einer Ebene, und in der Nähe der Düsenöffnung (17; 94; 126; 206), eine Mehrzahl von Vorsprüngen (96; 125; 202), die sich transversal zu der Ebene der Düsenöffnung (17; 94; 126; 206) erstrecken, worin die Höhe der Vorsprünge (96; 125; 202) unter der Ebene der Düsenöffnung (17; 94; 126; 206) ist, und, worin die Vorsprünge (96; 125; 202) voneinander beabstandet sind durch Räume (98; 124; 207, 210, 212) und jeder Raum (98; 124; 207, 210, 212) in Kommunikation steht mit Öffnungen (121), die unter vermindertem Druck gehalten werden.

14. Tropfenausstoßanordnung nach Anspruch 12 oder Anspruch 1, worin die Düsenöffnung (17; 94; 126; 206) und die Vorsprünge (96; 125; 202) in einem gemeinsamen Körper definiert sind.

15. Tropfenausstoßanordnung nach Anspruch 14, worin der Körper ein Siliziummaterial aufweist.

16. Tropfenausstoßanordnung nach Anspruch 1 oder Anspruch 12, aufweisend einen Kanal in der Nähe der Vorsprünge (96; 125; 202), wobei der Kanal die Öffnungen (121) beinhaltet.

17. Tropfenausstoßanordnung nach Anspruch 1 oder Anspruch 12, aufweisend eine Vakuumquelle oder ein Material mit Dochtwirkung in der Nähe der Vorsprünge (96; 125; 202).

18. Tropfenausstoßanordnung nach Anspruch 12, worin die Düsenöffnung (17; 94; 126; 206) in einem Loch bzw. einer Bohrung angeordnet ist und das Loch bzw. die Bohrung die Vorsprünge (96; 125; 202) beinhaltet.

19. Tropfenausstoßanordnung nach Anspruch 12, worin die Düsenöffnung (17; 94; 126; 206) auf einer Plattform angeordnet ist und die Vorsprünge (96; 125; 202) in der Nähe der Plattform angeordnet sind.

20. Tropfenausstoßanordnung nach Anspruch 1 oder Anspruch 12, worin die Düsenöffnungsbreite etwa 200 Mikrometer oder weniger beträgt.

21. Tropfenausstoßanordnung nach Anspruch 1 oder 12, aufweisend einen piezoelektrischen Aktuator.

22. Tropfenausstoßanordnung nach Anspruch 12, worin der Abstand zwischen den Vorsprüngen (96; 125; 202) zwischen etwa 20% der Düsenöffnungsbreite oder größer und dem Doppelten der Düsenöffnungsbreite oder weniger beträgt.

23. Tropfenausstoßanordnung nach Anspruch 1, worin die Vorsprünge (96; 125; 202) eine Breite aufweisen, die etwa das Doppelte der Düsenöffnung oder weniger beträgt.

24. Tropfenausstoßanordnung nach Anspruch 12, worin die Vorsprünge (96; 125; 202) in einem Muster angeordnet sind.

25. Tropfenausstoßanordnung nach Anspruch 8, worin die konzentrischen Räume so angeordnet sind, dass Tinte von einem Raum zu einem anderen Raum fließen kann.

Revendications

1. Un éjecteur de gouttes, comprenant :

un trajet d'écoulement dans lequel du fluide est mis sous pression pour éjecter des gouttes depuis une ouverture de buse (17 ; 94 ; 126 ; 206) dans un plan, et
à proximité de l'ouverture de buse (17 ; 94 ; 126 ; 206), une pluralité de saillies (96 ; 125 ; 202) s'étendant transversalement par rapport à un plan de l'ouverture de buse (17 ; 94 ; 126 ; 206), la hauteur des saillies (96 ; 125 ; 202) étant substantiellement égale au plan de l'ouverture de buse (17 ; 94 ; 126 ; 206), et
caractérisé en ce que
les saillies (96 ; 125 ; 202) sont espacées les unes des autres par des intervalles (98 ; 124 ; 207, 210, 212), et chaque intervalle (98 ; 124 ; 207, 210, 212) est en communication avec des ouvertures (121) maintenues sous pression réduite.

2. L'éjecteur de gouttes de la revendication 1, dans lequel l'ouverture de buse (17 ; 94 ; 126 ; 206) est entourée par les saillies (96 ; 125 ; 202).

3. L'éjecteur de gouttes de la revendication 1, dans lequel les saillies (96 ; 125 ; 202) comprennent des colonnes.

4. L'éjecteur de gouttes de la revendication 1, dans lequel les saillies (96 ; 125 ; 202) sont en forme de parois.

5. L'éjecteur de gouttes de la revendication 1, dans lequel les saillies (96 ; 125 ; 202) sont configurées en un motif.

6. L'éjecteur de gouttes de la revendication 5, dans lequel le motif définit un réseau de lignes et de colonnes.

7. L'éjecteur de gouttes de la revendication 5, dans lequel le motif définit un arc.

8. L'éjecteur de gouttes de la revendication 5, dans lequel le motif définit des intervalles concentriques de recueil d'encre.

9. L'éjecteur de gouttes de la revendication 1, dans lequel les saillies (96 ; 125; 202) présentent une largeur qui est environ deux fois celle de la largeur de l'ouverture de buse ou moins.

10. L'éjecteur de gouttes de la revendication 1, comprenant en outre le fait que l'ouverture de buse (17 ; 94 ; 126 ; 206) présente un périmètre et une largeur d'ouverture de buse, les saillies (96 ; 125 ; 202) n'étant pas plus proches du périmètre de l'ouverture de buse (17 ; 94 ; 126 ; 206) qu'environ 20 % de la largeur de l'ouverture de buse.

11. L'éjecteur de gouttes de la revendication 1, dans lequel l'intervalle entre les saillies (96 ; 125 ; 202) est environ double de la largeur de buse ou moins.

12. L'éjecteur de gouttes de la revendication 1, dans lequel le nombre des saillies (96 ; 125 ; 202) est de quatre ou plus.

13. Un éjecteur de gouttes, comprenant :

un trajet d'écoulement dans lequel du fluide est mis sous pression pour éjecter des gouttes depuis une ouverture de buse (17 ; 94 ; 126 ; 206) dans un plan, et
à proximité de l'ouverture de buse (17 ; 94 ; 126; 206), une pluralité de saillies (96 ; 125 ; 202) s'étendant transversalement par rapport au plan de l'ouverture de buse (17 ; 94 ; 126 ; 206), la hauteur des saillies (96 ; 125 ; 202) étant audessous du plan de l'ouverture de buse (17 ; 94 ; 126 ; 206), et les saillies (96 ; 125 ; 202) sont espacées les unes des autres par des intervalles (98 ; 124 ; 207, 210, 212), et chaque intervalle (98 ; 124 ; 207, 210, 212) est en communication avec des ouvertures (121) maintenues sous pression réduite.

14. L'éjecteur de gouttes de la revendication 12 ou de la revendication 1, dans lequel l'ouverture de buse (17 ; 94 ; 126 ; 206) et les saillies (96 ; 125 ; 202) sont définies dans un corps commun.

15. L'éjecteur de gouttes de la revendication 14, dans lequel le corps comprend un matériau de silicium.

16. L'éjecteur de gouttes de la revendication 1 ou de la revendication 12, comprenant un canal à proximité des saillies (96 ; 125 ; 202), le canal incluant les ouvertures (121).

17. L'éjecteur de gouttes de la revendication 1 ou de la revendication 12, comprenant une source de vide ou un matériau à effet de mèche à proximité des saillies (96 ; 125 ; 202).

18. L'éjecteur de gouttes de la revendication 12, dans lequel l'ouverture de buse (17 ; 94 ; 126 ; 206) est disposée dans un puits et le puits comprend lesdites saillies (96 ; 125 ; 202).

19. L'éjecteur de gouttes de la revendication 12, dans lequel l'ouverture de buse (17 ; 94 ; 126 ; 206) est disposée sur une plateforme et les saillies (96 ; 125 ; 202) sont disposées à proximité de la plateforme.

20. L'éjecteur de gouttes de la revendication 1 ou de la revendication 12, dans lequel la largeur de l'ouverture de buse est d'environ 200 microns ou moins.

21. L'éjecteur de gouttes de la revendication 1 ou de la revendication 12, comprenant un actionneur piézoélectrique.

22. L'éjecteur de gouttes de la revendication 12, dans lequel l'intervalle entre lesdites projections (96 ; 125 ; 202) est compris entre environ 20 % de la largeur de l'ouverture de buse ou plus et deux fois la largeur de l'ouverture de buse ou moins.

23. L'éjecteur de gouttes de la revendication 1, dans lequel les saillies (96 ; 125 ; 202) présentent une largeur qui est environ double de l'ouverture de buse ou moins.

24. L'éjecteur de gouttes de la revendication 12, dans lequel les saillies (96 ; 125 ; 202) sont configurées en un motif.

25. L'éjecteur de gouttes de la revendication 8, dans lequel les intervalles concentriques sont disposés de telle sorte que l'encre puisse se déplacer d'un intervalle à un autre intervalle.

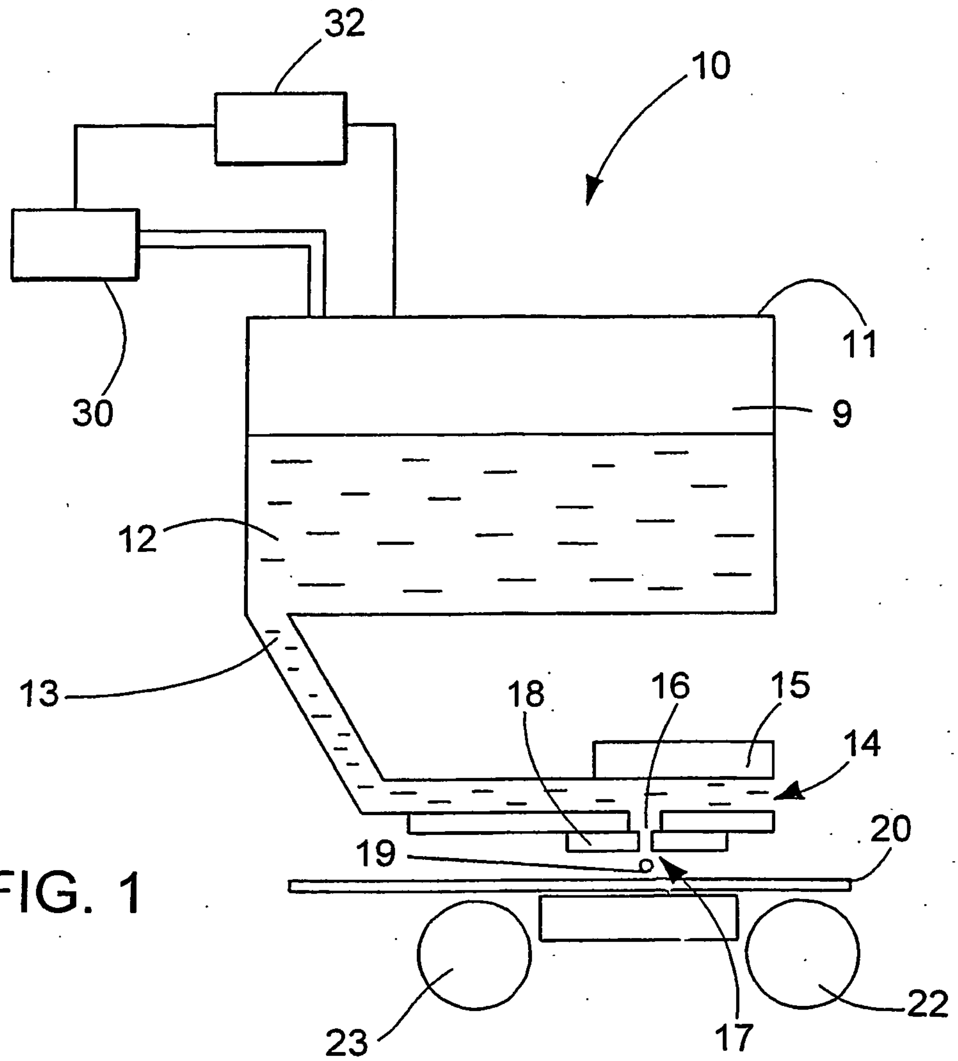

FIG. 1

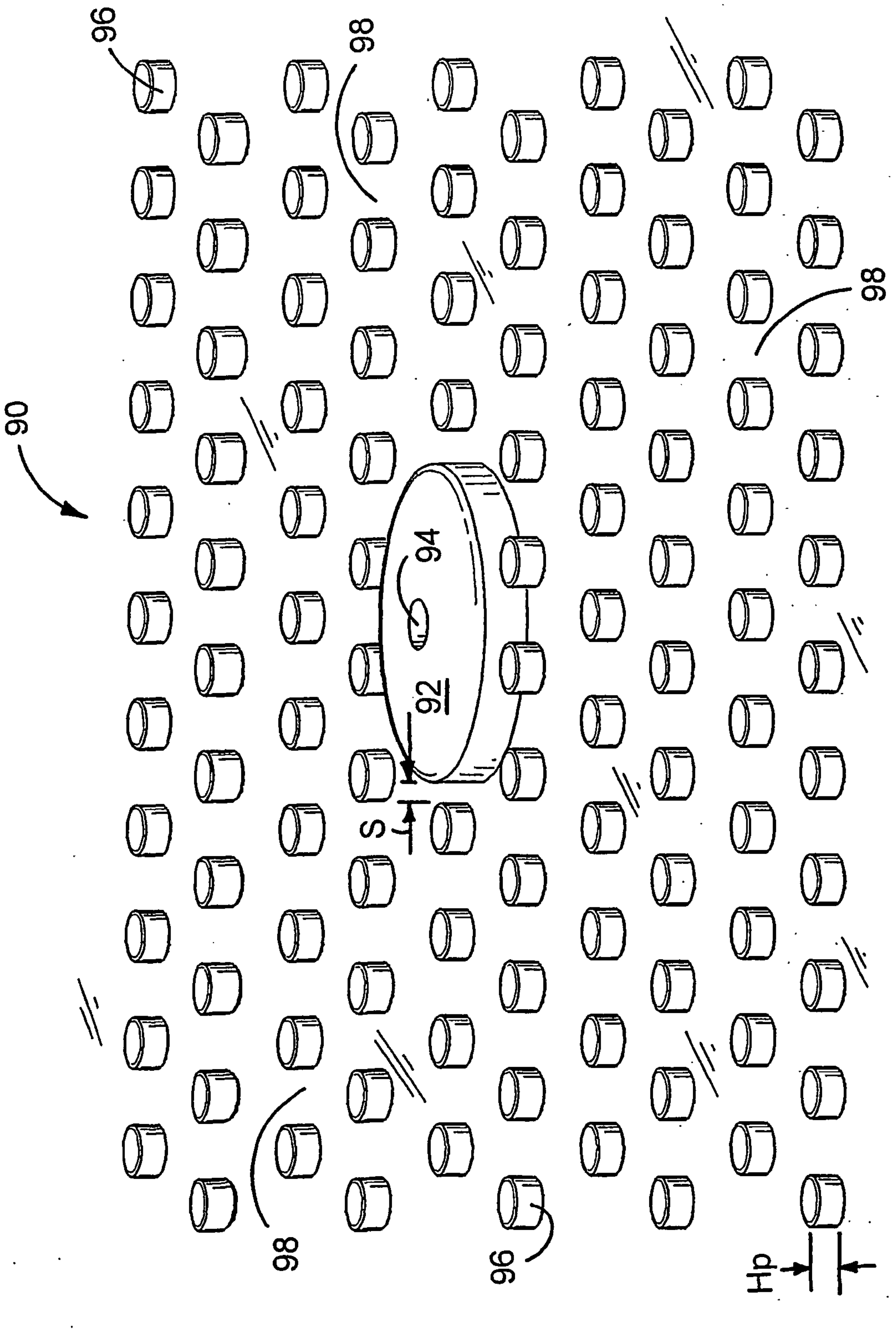

FIG. 2

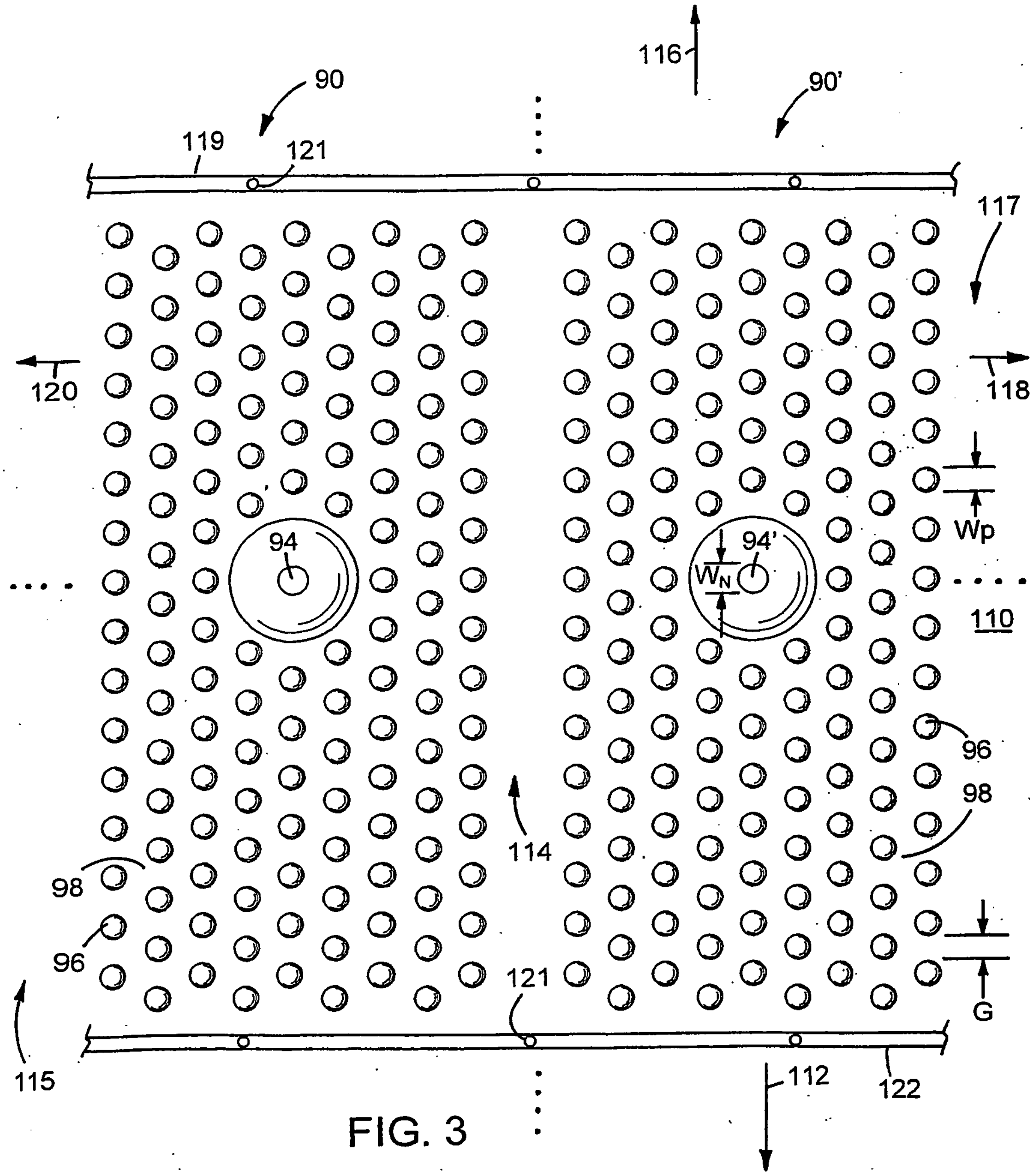
116
90
90'
119
121
117
120
118
Wp
94
94'
W_N
110
96
98
114
98
96
121
G
115
112
122

FIG. 3

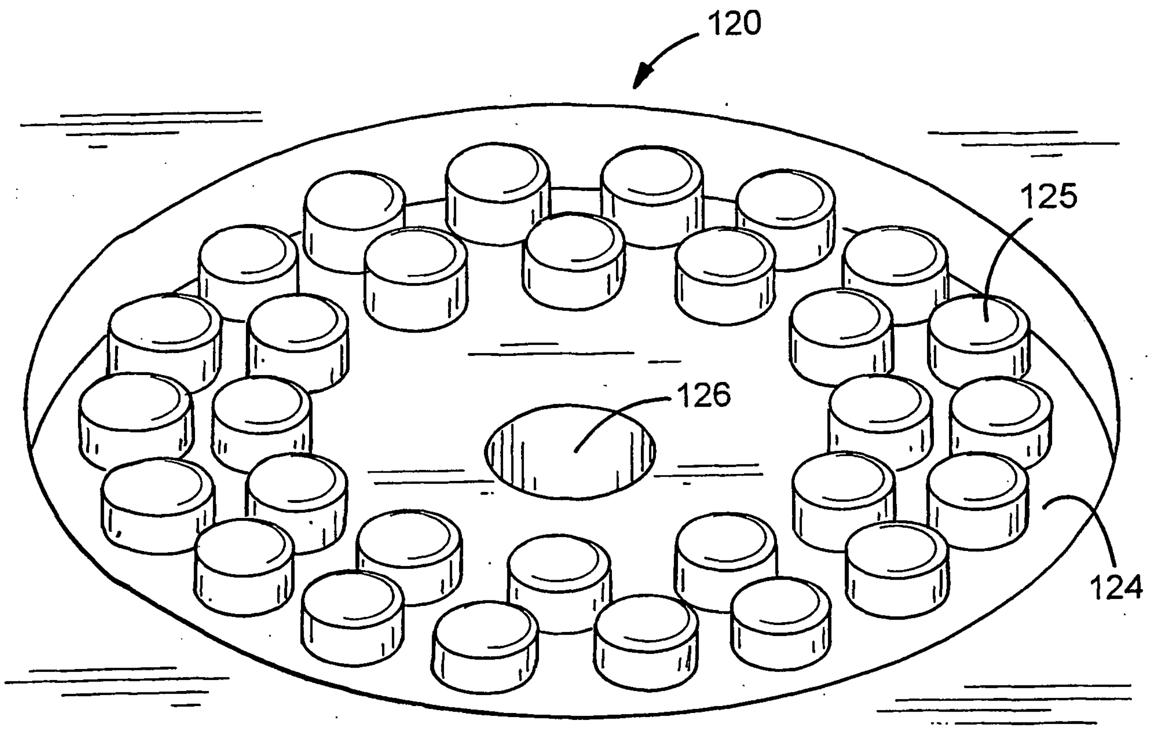

FIG. 4

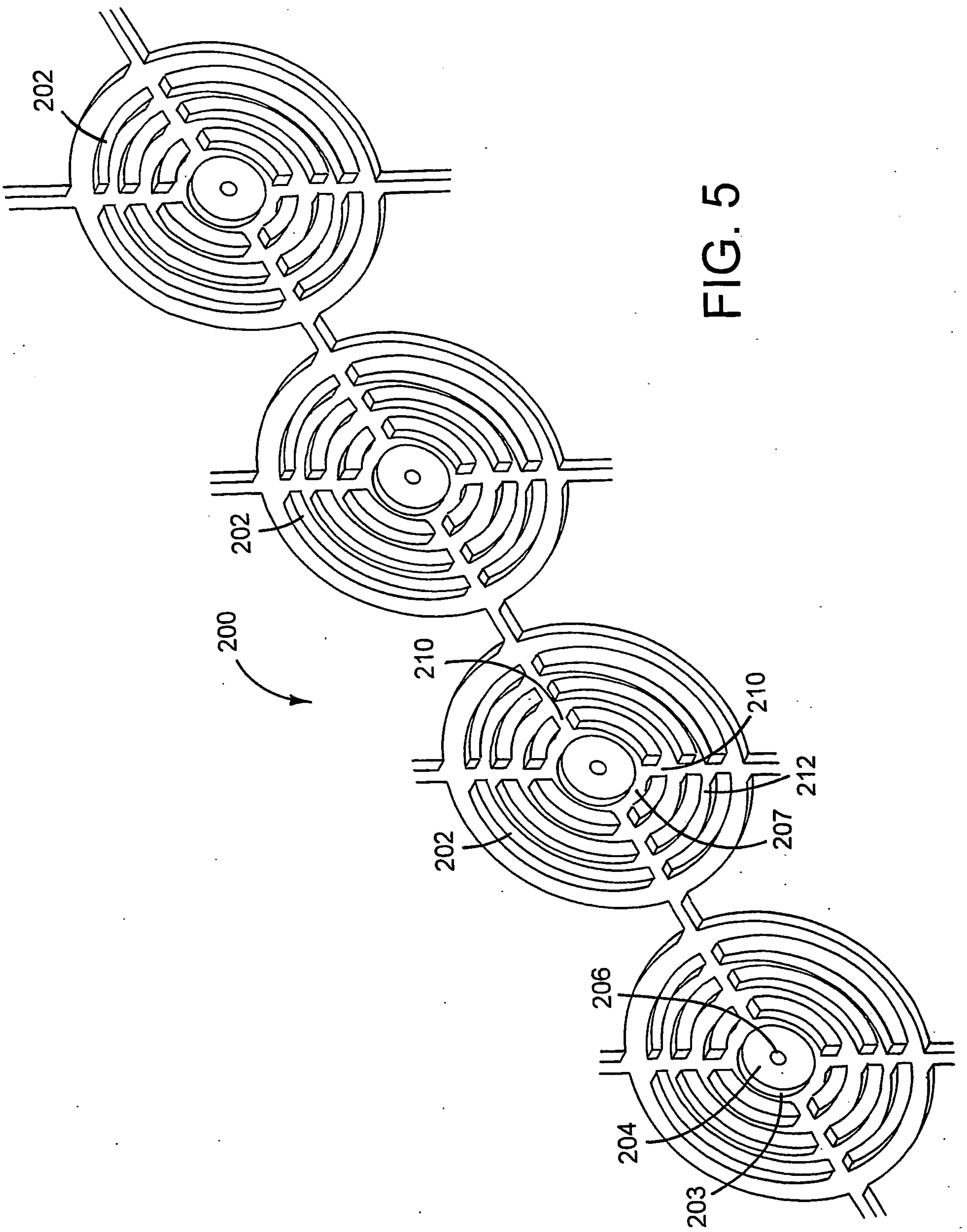

FIG. 5

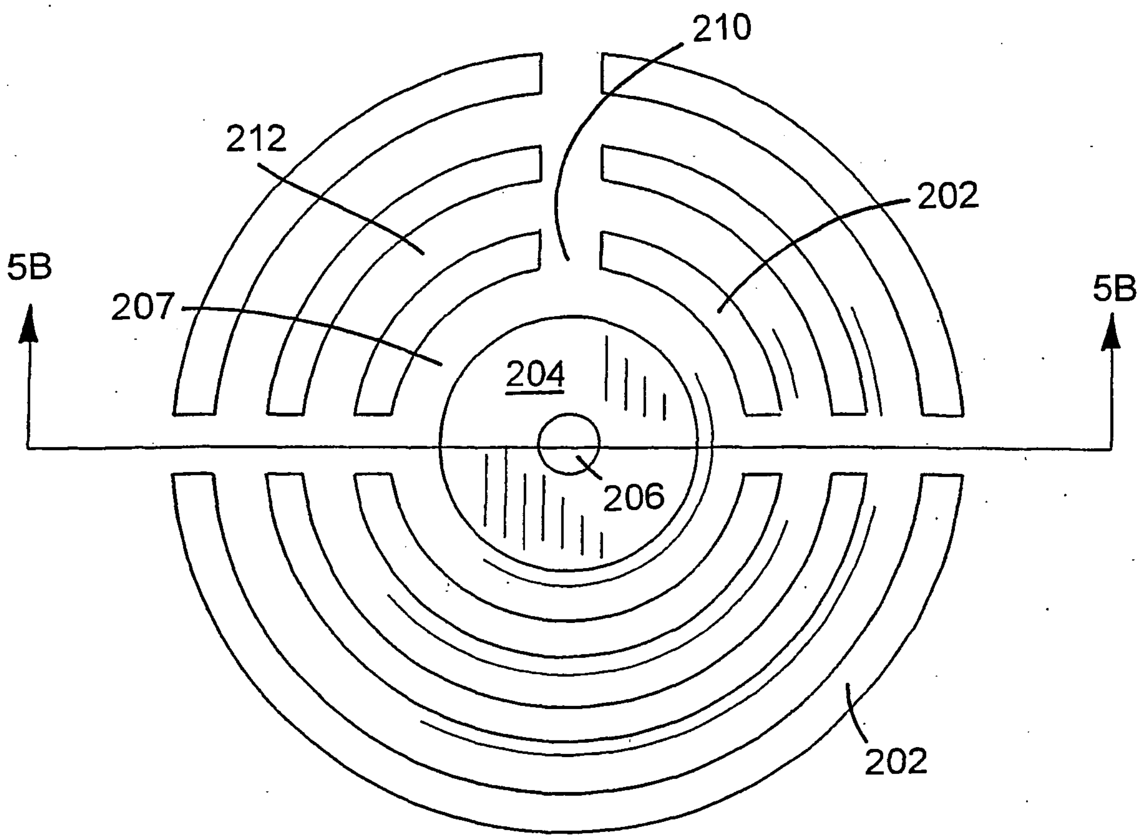

FIG. 5A

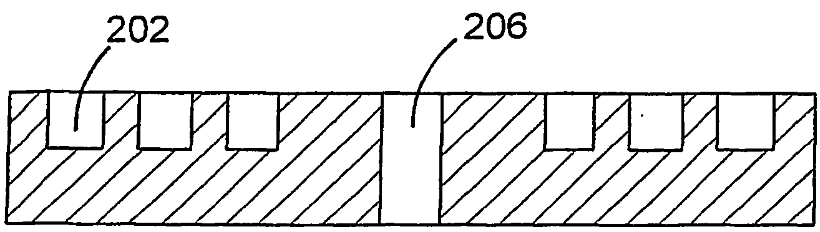

FIG. 5B

REFERENCES CITED IN THE DESCRIPTION

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