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(54) Internal support for top-shooter thermal ink-jet printhead

Interner Träger für die Düsendeckplatte eines thermischen Tintenstrahldruckkopfes

Support interne pour la plaque de tuyères supérieure d'une tête à jet d'encre thermique

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(73) Proprietor: **Hewlett-Packard Company**
Palo Alto, California 94304 (US)

(72) Inventors:
- **Fong Ho, May**
  La Mesa, California 91941 (US)
- **Tappon, Ellen**
  Corvallis, Oregon 97330 (US)

(74) Representative: **Colgan, Stephen James**
CARPMAELS & RANSFORD
43 Bloomsbury Square
London WC1A 2RA (GB)

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Description

The present invention relates to printheads employed in ink-jet printers, and, more particularly, to control of internal particle contamination.

Ink-jet pens comprise a reservoir of ink and a printhead comprising a plurality of orifices from which ink is expelled toward a print medium, such as paper. Between the reservoir of ink and the printhead are passages, including a plurality of firing chambers and a plenum for supplying ink to the firing chambers. Each firing chamber includes a resistive heating element, which is energized upon demand to fire a droplet, or bubble, of ink through the orifice associated with that resistor.

The orifices through which the ink is expelled in the printhead are on the order of 50 μm in diameter. The passages can be as small as widths of ~40 μm and heights of ~25 μm. Any particles larger than about 25 μm can become trapped at various locations within the pen in or near the firing chamber and cause clogging. Of course, smaller particles can also become trapped, depending on the aspect ratio of the particle. Such clogging, of course, interferes with the quality of the printed image.

Present ink-jet pens have a fine mesh filter to separate internal particle contamination from the bulk ink supply before the ink reaches the firing chambers. The mesh is sized to about 25 μm. However, as ink-jet technology is used to produce higher resolution printing, a smaller diameter jet, or orifice, is required. This is achieved by decreasing printhead nozzle diameter. As a result, an increase in the internal particle problem is anticipated. If this is true, then a finer mesh filter may be required, which in turn would require a larger filter area so as to minimize pressure drop across the filter. These changes would affect pen design, cost, and manufacturing strategy.

In US-A-4882595 there is disclosed an ink-jet printhead including a plurality of ink-propelling elements, each of which comprises a resistor element disposed in a separate drop ejection chamber. The drop ejection chamber is defined by three barrier walls and a fourth side which is open to a reservoir of ink common to at least some of the ink-propelling elements and which defines a barrier inlet channel. The printhead also includes a plurality of nozzles comprising orifices disposed in a cover plate near the ink-propelling elements for ejecting a quantity of ink through the orifices towards a print medium in defined patterns to form alphanumeric characters and graphics thereon, and a common ink feed channel fluidically connected to the reservoir of ink to accept a flow of ink therefrom and fluidically connected to the barrier inlet channel. Ink is supplied to each ink-propelling element from the common ink feed channel through the barrier inlet channel, the distance from the ink feed channel to the entrance of each barrier inlet channel defining a shelf length of the printhead.

A solution to the problem of particle contamination is addressed by EP-A-0500068. In this document an ink jet recording head is provided which includes a plurality of ejection outlets for ejecting ink, discrete ink passages communicating with respective ejection outlets, a common liquid passage communicating with the discrete ink passages for supplying ink thereto, a liquid chamber for supplying the ink to the common ink passages, and a filter. The filter comprises a plurality of projections between the common liquid passage and the liquid chamber for preventing foreign matter from entering the discrete liquid passages.

However, a further problem exists in the construction of pens employing an ink feed channel acting as a common reservoir of ink. Namely, a nozzle plate, which contains the nozzles through which the ink is expelled, tends to sag in unsupported areas, including over the ink feed channel. Such pens are referred to as "top-shooter" or "roof-shooter" pens. The sagging nozzle plate can pinch off the supply of ink, thereby reducing the usefulness of the pen.

The above-mentioned European Patent Application is directed to the so-called "side-shooter" thermal ink-jet configuration, and this configuration does not have a common ink refill channel through the substrate on which the firing resistors are formed, but rather has a plurality of orifices through the top of a cover plate for introducing ink into a common area. There appears to be no problem with sag of the cover plate associated with the side-shooter configuration. Accordingly, there remains a need to support the nozzle plate in the vicinity of the ink feed channel and to remove particle contamination from the ink in ink-jet pens.

In accordance with the present invention, there is provided an ink-jet printhead as specified in the claims hereinafter.

The pillars are spaced apart by an amount less than or equal to the smallest dimension of the system, and are placed as close as possible to the common ink feed channel so as to support the orifice plate and keep particles outside the firing chamber. The smallest dimension of the system is likely to be either the nozzle size or the width of the passageway (the barrier inlet channel) connecting the source of ink to the firing chamber.

The pillars, being formed from the barrier material and hence the same height as the barrier material, act as support pillars between the substrate and the orifice plate, thereby avoiding any pinching effect that would otherwise occur for an unsupported region. Advantageously, spacing the pillars as indicated above prevents internal particle contamination that is trapped inside the ink-jet printhead during assembly from detrimentally affecting ink-jet formation and performance.

FIG. 1 is a perspective view of a resistor and barrier inlet channel in relation to an ink feed channel, or plenum, of a prior art thermal ink-jet printhead design;

FIG. 2 is a perspective view of a barrier reef design in accordance with the invention; and

FIG. 3 is a top plan view of a portion of the barrier reef in association with the ink feed channel and barrier inlet channel, in accordance with the invention.

Referring now to the drawings where like numerals of reference denote like elements throughout, FIG. 1 depicts a printing or drop ejecting element **10**, formed on a substrate **12**. Each firing element **10** comprises a barrier inlet channel, or discrete ink passage, **14**, with a resistor **16** situated at one end **14a** thereof. The barrier inlet channel **14** and drop ejection chamber **15** encompassing the resistor **16** on three sides are formed in a layer **17** which comprises a photopolymerizable material which is appropriately masked and etched/developed to form the desired patterned opening. This material **17** is often referred to as a barrier layer.

Ink (not shown) is introduced at the opposite end **14b** of the barrier inlet channel **14**, as indicated by arrow "**A**", from an ink feed channel, or common liquid passage, indicated generally at **18**. The ink feed channel **18** passes through the substrate **12** and is provided with a continuous supply of ink from an ink reservoir (not shown), located beneath the substrate.

Associated with each resistor **16** is a nozzle **20**, located near the resistor in a nozzle plate **22**. Droplets of ink are ejected through the nozzle (e.g., normal to the plane of the resistor **16**) upon heating of a quantity of ink by the resistor. Each drop ejection chamber **15**, the resistor **16** therein, and the associated nozzle **20** may be collectively referred to as an ejection outlet for ejecting ink.

A pair of opposed projections **24** at the entrance to the barrier inlet channel **14** define the channel width, as indicated by the arrow "**B**".

Each such printing element **10** comprises the various features set forth above. Each resistor **16** is seen to be set in a drop ejection chamber **15** defined by three barrier walls and a fourth side open to the ink feed channel **18** of ink common to at least some of the elements **10**, with a plurality of nozzles **20** comprising orifices disposed in a cover plate **22** near the resistors **16**. Each orifice **20** is thus seen to be operatively associated with a resistor **16** for ejecting a quantity of ink normal to the plane defined by that resistor and through the orifices toward a print medium (not shown) in defined patterns to form alphanumeric characters and graphics thereon.

Ink is supplied to each element **10** from the ink feed channel **18** by means of the barrier inlet channel **14**. Each drop ejection chamber **15** is provided with a pair of opposed projections **24** formed in the walls of the barrier layer **17** at the entrance of the barrier inlet channel **14** and separated by a width "**B**" to define the channel width. Each firing element **10** may be provided with lead-in lobes **24a** disposed between the projections **24** and separating one barrier inlet channel **14** from a neighboring barrier inlet channel **14'**.

In accordance with the invention, a "barrier reef" configuration, comprising a plurality of pillars **26**, is provided. Each pillar **26** is associated with the entrance to a firing chamber **15** by placement between the barrier inlet channel **14** to that firing chamber and the ink feed channel **18**.

The barrier reef design of the invention is achieved by modifying the barrier mask to add elliptical pillars **26** along the edge of the ink feed channel **18**. That is, the pillars **26** are formed at the same time the barrier layer **17** is processed to form the barrier inlet channels **14**, the firing chambers **15**, and the like therein. Thus, the pillars **28** are the same height as the barrier layer **17**. The major axis of the each pillar **26** is perpendicular to the ink flow from the ink feed channel **18** to the barrier inlet channel **14**.

FIGS. 2 and 3 show the barrier reef configuration of the invention. The spacing between these pillars **26** is designed so as to provide support for orifice plate **22** in the vicinity of the ink feed channel **18** and to filter out internal particles from ink before the particles reach the barrier inlet channel **14**. Dust or other contamination particles will be caught by these pillars **26** at locations far enough from each individual nozzle **20** so as not to affect nozzle performance.

The main design goal is to optimize the size and spacing of the reef pillars:

1. to minimize ink flow resistance for refill of the drop ejection chamber **15**;
2. to ensure good adhesion through life of pen; and
3. to minimize deflection of the orifice plate **22** over the ink feed channel **18** and thereby avoid pinch-off of the ink in the otherwise unsupported region.

There is a tradeoff between the operational frequency and the ink flow. It is important to balance the dimension of the barrier inlet channel **14**, the configuration of the barrier reef **26** (dimensions and spacing), and the distance between the resistor **16** and the ink feed channel **18** in order to maintain a high operating frequency, which requires rapid refill, consistent with damping during the refill to avoid fluid oscillation.

In order to accomplish this goal, the length C of the barrier inlet channel **14** is decreased, compared to the prior art design. This maintains the operating frequency to offset the increased fluid resistance due to the presence of the pillars **26**. In this connection, for one particular design configuration, the value of the length of the barrier inlet channel **14** was reduced by about 15% from the prior art configuration. This correction was found to be effective so that there was no change in print quality on paper in comparison to the prior art configuration when printing at the required speed.

The minimum spacing **D** between each pillar **26** should be less than the minimum dimension of the system. Thus, from the above discussion, it is clear that the size of the orifice **20** is the dictating dimension. However, an alternative possible limiting dimension is the width **B** of the barrier inlet channel **14**.

The dimension of each pillar **26** is related to the

spacing between resistors 16 (resistor-to-resistor spacing, center-to-center) less the spacing between pillars. Essentially, the center of each pillar 26 is aligned with the center of each resistor 16.

An additional consideration includes the relationship of the size of the pillar 26 to the resistance to flow of the ink to the nozzle 20. Larger pillars 26 tend to increase the resistance to the flow of the ink, and thereby decrease the operating frequency of the device. As indicated above, the operating frequency is maintained at a desired high value by decreasing the fluid flow resistance between the resistor 16 and the ink feed channel 18. Such a decrease can be done by reducing the length of the barrier inlet channel 14 or by shortening the shelf length (the shelf is that distance from the edge of the ink feed channel 18 to the entrance to the barrier inlet channel), or a combination thereof.

On the other hand, the pillar 26 cannot be made too small, or it will not adhere to the substrate 12 throughout the usable life of the printhead.

The distance from the pillar 26 to the center of the resistor 16 is another factor that may be adjusted. In general, the longer that distance, the better, so as to allow flow from a larger area near the entrance to the barrier inlet channel 14, if a contamination particle is caught at the pillars, thus blocking ink flow from the ink feed channel 18, basically making the presence of pillars 26 transparent to resistor operation.

The pillars 26 are placed as close to the edge of the ink feed channel 18 as possible. In this way, it serves to screen particles, keeping them in the common area. Preferably, the pillars 26 are placed as close to the edge of the ink feed channel 18 as manufacturing tolerance will allow for the processing of substrate 12. Further, since the pillar 26 is the same height as the barrier layer 17, and is in fact formed during the definition of the barrier layer, it serves as a support pillar to prevent partial collapse of the nozzle plate 22 in the unsupported region, namely, at the edge of the ink feed channel 18. Such partial collapse in prior art pen designs has been responsible for pinching off ink flow over the life of the pen and causing dot placement errors.

For a pen operating at a given dot-per-inch (dpi) and having as its smallest dimension x_{min}, here, the diameter of orifice 20, the following relationships are obtained:

pillar spacing (ps) $\leq x_{min}$;
pillar major axis diameter = $(dpi)^{-1}$ - ps;
pillar minor axis diameter $\geq y_{min}$,

where y_{min} is the smallest dimension that would still provide good adhesion throughout the useful life of the pen. For example, present processing techniques require that y_{min} = 50 µm. The length of the barrier inlet channel 14 is then reduced from the prior art design by an amount equivalent to about 10 to 20% of the value of y_{min}.

Using an elliptical cross-section permits narrower spacing between the pillars 26 to accommodate smaller orifices 20, yet allowing larger pillars without significantly incr easing ink flow resistance.

Use of the reef configuration of the invention permits use of the present filter mesh. There is no need to change to a finer mesh filter.

The advantages of the invention are:

1. No additional processing step is needed.
2. The pillar gap can be adjusted to achieve the best contamination control for each ink-jet printhead design.
3. The pillar design can be modified by using different geometry to optimize adhesion to substrate.
4. The pillar design can be modified to provide fluid damping and refill control in addition to functioning as internal particle contamination control.
5. The pillars can act as support pillars between the substrate and the orifice plate for manufacturing and during operation.
6. Increased adhesion of the orifice plate for the life of the pen.

The use of a plurality of pillars in thermal ink-jet printheads is expected to find use in pens capable of operating at high frequencies and smaller nozzles.

Claims

1. An ink-jet printhead in an ink-jet pen including:

(a) a plurality of ink-propelling elements (10), each ink-propelling element (10) being formed on a top surface of a substrate (12) and disposed in a separate drop ejection chamber (15) defined by three barrier walls formed in a barrier layer (17) on said top surface of said substrate (12) and an open side of said chamber (15) leading to a reservoir of ink common to at least some of said ink-propelling elements (10) and defining a barrier inlet channel (14);
(b) a plurality of nozzles (20) comprising orifices disposed in a cover plate (22) near said ink-propelling elements (10), each orifice operatively associated with an ink-propelling element (10) for ejecting a quantity of ink normal to the plane defined by each said element (10) and through said orifices toward a print medium in defined patterns to form alphanumeric characters and graphics thereon;
(c) a common ink feed channel (18) fluidically connected to said reservoir of ink beneath said substrate (12) to accept a flow of ink therefrom and fluidically connected to said barrier inlet channel (14), said ink feed channel (18) defining an edge on said top surface of said substrate, wherein ink is supplied to each said ink-propelling element (10) from said common ink feed channel (18) through said barrier inlet

channel (14), the distance from said ink feed channel (18) to the entrance of each said barrier inlet channel (14) defining a shelf length of said printhead; and

(d) a plurality of pillars (26), positioned along said edge of said ink feed channel (18) opposite said entrance to said barrier inlet channel (14), wherein each said pillar (26) has an elliptical cross-section, with the major axis of each elliptical pillar extending perpendicular to ink flow (A) from said common ink feed channel (18) to said ink-propelling elements (10).

2. The ink-jet printhead of claim 1, wherein an edge of each pillar (26) is separated from the closest edge of an adjacent pillar (26) by a distance (D) that is no greater than the smaller of the following dimensions: the diameter of said orifices (20) and the width (B) of said barrier inlet channels (14).

3. The ink-jet printhead of claim 1 or claim 2, wherein each pillar (26) is the same height as said barrier layer (17) for supporting said cover plate (22) near said ink feed channel (18).

4. The ink-jet printhead of any one of claims 1 to 3, wherein each pillar (26) is associated with the entrance to each said barrier inlet channel (14).

5. The ink-jet printhead of claim 4, wherein there is one pillar (26) per barrier inlet channel (14), each pillar (26) being centred with respect to said entrance of each barrier inlet channel (14).

6. The ink-jet printhead of any one of the preceding claims, wherein each said ink-propelling element (10) is a resistor (16), and wherein each said resistor comprises a planar area, with said droplets of ink being fired normal to said planar area through said orifices (20).

7. The ink-jet printhead of any one of the preceding claims, wherein the length of said major axis is given by the equation $(dpmm)^{-1}$ - pillar spacing, where dpmm is the number of dots per millimetre printable by said printhead and where pillar spacing is the distance between the closest edges of adjacent pillars (26), and wherein the length of the minor axis of each elliptical pillar (26) is at least that dimension that would provide good adhesion of said pillar (26) to said substrate (12) throughout the useful life of said pen.

Patentansprüche

1. Ein Tintenstrahldruckkopf in einem Tintenstrahlstift mit folgenden Merkmalen:

(a) einer Mehrzahl von Tintenantriebselementen (10), wobei jedes Tintenantriebselement (10) auf einer oberen Oberfläche eines Substrats (12) gebildet und in einer getrennten Tropfenausstoßkammer (15) angeordnet ist, die durch drei Barrierenwände, die in einer Barrierenschicht (17) auf der oberen Oberfläche des Substrats (12) gebildet sind, und eine offene Seite der Kammer (15), die zu einem Tintenbehälter führt, den zumindest einige der Tintenantriebselemente (10) gemeinsam verwenden, und die einen Barriereneinlaßkanal (14) definiert, definiert ist;

(b) einer Mehrzahl von Düsen (20), die Öffnungen aufweisen, die in einer Abdeckplatte (22) in der Nähe der Tintenantriebselemente (10) angeordnet sind, wobei jede Öffnung wirksam einem Tintenantriebselement (10) zugeordnet ist, um eine Tintenmenge senkrecht zu der Ebene, die durch das Element (10) definiert ist, und in definierten Mustern durch die Öffnungen zu einem Druckmedium auszustoßen, um alphanumerische Zeichen und Graphiken auf demselben zu bilden;

(c) einem gemeinsamen Tintenzufuhrkanal (18), der fluidmäßig mit dem Tintenbehälter unterhalb des Substrats (12) verbunden ist, um einen Tintenfluß aus demselben aufzunehmen, und der mit dem Barriereneinlaßkanal (14) fluidmäßig verbunden ist, wobei der Tintenzufuhrkanal (18) eine Kante auf der oberen Oberfläche des Substrats definiert, wobei Tinte von dem gemeinsamen Tintenzufuhrkanal (18) durch den Barriereneinlaßkanal (14) zu jedem der Tintenantriebselemente geliefert wird, wobei der Abstand von dem Tintenzufuhrkanal (18) zu dem Eingang des Barriereneinlaßkanals (14) eine Schelflänge des Druckkopfs definiert; und

(d) einer Mehrzahl von Stützen (26), die entlang der Kante des Tintenzufuhrkanals (18) gegenüber dem Eingang des Barriereneinlaßkanals (14) positioniert sind, wobei jede der Stützen (26) einen elliptischen Querschnitt aufweist, wobei die Hauptachse jeder elliptischen Stütze sich senkrecht zu dem Tintenfluß (A) von dem gemeinsamen Tintenzufuhrkanal (18) zu den Tintenantriebselementen (10) erstreckt.

2. Tintenstrahldruckkopf gemäß Anspruch 1, bei dem eine Kante jeder Stütze (26) von der nächstliegenden Kante einer benachbarten Stütze (26) um einen Abstand (D) getrennt ist, der nicht größer ist als die kleinste der folgenden Abmessungen ist: der Durchmesser der Öffnungen (20) und die Breite (B) der Barriereneinlaßkanäle (14).

3. Der Tintenstrahldruckkopf gemäß Anspruch 1 oder Anspruch 2, bei dem jede Stütze (26) die gleiche Höhe wie die Barrierenschicht (17) zum Tragen der Abdeckungsplatte (22) in der Nähe des Tintenzuführkanals (18) aufweist.

4. Der Tintenstrahldruckkopf gemäß einem der Ansprüche 1 bis 3, bei dem jede Stütze (26) dem Eingang zu jedem Barriereneinlaßkanal (14) zugeordnet ist.

5. Der Tintenstrahldruckkopf gemäß Anspruch 4, bei dem eine Stütze (26) pro Barriereneinlaßkanal (14) existiert, wobei jede Stütze (26) bezüglich des Eingangs des Barriereneinlaßkanals (14) zentriert ist.

6. Der Tintenstrahldruckkopf gemäß einem beliebigen der vorhergehenden Ansprüche, bei dem das Tintenantriebselement (10) ein Widerstand (16) ist, und bei dem der Widerstand einen planaren Bereich aufweist, wobei die Tintentröpfchen senkrecht zu dem planaren Bereich durch die Öffnungen (20) abgeschossen werden.

7. Der Tintenstrahldruckkopf gemäß einem beliebigen der vorhergehenden Ansprüche, bei dem die Länge der Hauptachse durch die Gleichung $(dpmm)^{-1}$ - Stützenabstand gegeben ist, wobei dpmm die Anzahl von Punkten pro Millimeter ist, die durch den Druckkopf gedruckt werden kann, und wobei der Stützenabstand der Abstand zwischen den nächstliegenden Kanten benachbarter Stützen (26) ist, und wobei die Länge der Nebenachse jeder elliptischen Stütze (26) zumindest die Abmessung ist, die ein gutes Anhaften der Stütze an dem Substrat (12) während der gesamten nutzbaren Lebensdauer des Stifts liefern würde.

Revendications

1. Tête d'impression à jet d'encre située dans une cartouche à jet d'encre, comportant :

   (a) plusieurs éléments de propulsion d'encre (10), chaque élément de propulsion d'encre (10) étant formé sur une surface supérieure d'un substrat (12) et agencé dans une chambre d'éjection de goutte séparée (15) définie par trois parois formant barrière formées dans une couche de barrière (17) située sur ladite surface supérieure dudit substrat (12) et un côté ouvert de ladite chambre (15) aboutissant à un réservoir d'encre commun à au moins certains desdits éléments de propulsion d'encre (10) et définissant un canal d'entrée de barrière (14),
   (b) plusieurs buses (20) comportant des orifices agencés dans une plaque de couvercle (22), situés à proximité desdits éléments de propulsion d'encre (10), chaque orifice étant associé de manière opérationnelle à un élément de propulsion d'encre (10) pour éjecter une quantité d'encre perpendiculairement au plan défini par chaque dit élément (10) et à travers lesdits orifices en direction d'un support d'impression, selon des configurations définies pour former des caractères alphanumériques et des graphiques sur celui-ci,
   (c) un canal commun d'acheminement d'encre (18) relié hydrauliquement audit réservoir d'encre situé en dessous dudit substrat (12) pour accepter un écoulement d'encre à partir de celui-ci, et relié hydrauliquement auxdits canaux d'entrée de barrière (14), ledit canal d'acheminement d'encre (18) définissant un bord de ladite surface supérieure dudit substrat, dans laquelle l'encre est envoyée vers chacun desdits éléments de propulsion d'encre (10) depuis ledit canal d'acheminement d'encre commun (18) à travers ledit canal d'entrée de barrière (14), la distance depuis ledit canal d'acheminement d'encre (18) jusqu'à l'entrée de chaque dit canal d'entrée de barrière (14) définissant une longueur de tablette de ladite tête d'impression, et
   (d) plusieurs piliers (26), positionnés le long dudit bord dudit canal d'acheminement d'encre (18) à l'opposé de ladite entrée vers ledit canal d'entrée de barrière (14), dans laquelle chaque dit pilier (26) a une section transversale elliptique, le grand axe de chaque pilier elliptique s'étend perpendiculairement à l'écoulement d'encre (A) en provenance dudit canal d'acheminement d'encre commun (18) vers lesdits éléments de propulsion d'encre (10).

2. Tête d'impression à jet d'encre selon la revendication 1, dans laquelle un bord de chaque pilier (26) est séparé du bord le plus proche d'un pilier adjacent (26) d'une distance (D) qui est inférieure ou égale à la plus petite des dimensions qui suivent : le diamètre desdits orifices (20) et la largeur (B) desdits canaux d'entrée de barrière (14).

3. Tête d'impression à jet d'encre selon la revendication 1 ou 2, dans laquelle chaque pilier (26) a la même hauteur que ladite couche de barrière (17) pour supporter ladite plaque de couvercle (22) à proximité dudit canal d'acheminement d'encre (18).

4. Tête d'impression à jet d'encre selon l'une quelconque des revendications 1 à 3, dans laquelle chaque pilier (26) est associé à l'entrée de chaque dit canal d'entrée de barrière (14).

5. Tête d'impression à jet d'encre selon la revendication 4, dans laquelle existe un pilier (26) par canal d'entrée de barrière (14), chaque pilier (26) étant centré par rapport à ladite entrée de chaque canal

d'entrée de barrière (14).

6. Tête d'impression à jet d'encre selon l'une quelconque des revendications précédentes, dans laquelle chaque dit élément de propulsion d'encre (10) est une résistance (16), dans laquelle chaque dite résistance comporte une zone plane, lesdites gouttelettes d'encre étant propulsées perpendiculairement à ladite zone plane à travers lesdits orifices (20).

7. Tête d'impression à jet d'encre selon l'une quelconque des revendications précédentes dans laquelle la longueur dudit grand axe est donnée par l'équation $(dpmm)^{-1}$ - écartement entre piliers, où dpmm est le nombre de points par millimètre pouvant être imprimé par ladite tête d'impression et où l'écartement entre piliers est la distance existant entre les bords les plus proches de piliers adjacents (26), et dans laquelle la longueur du petit axe de chaque pilier elliptique (26) est au moins la dimension qui fournit une bonne adhérence dudit pilier (26) sur ledit substrat (12) pendant toute la durée de vie utile de ladite cartouche.

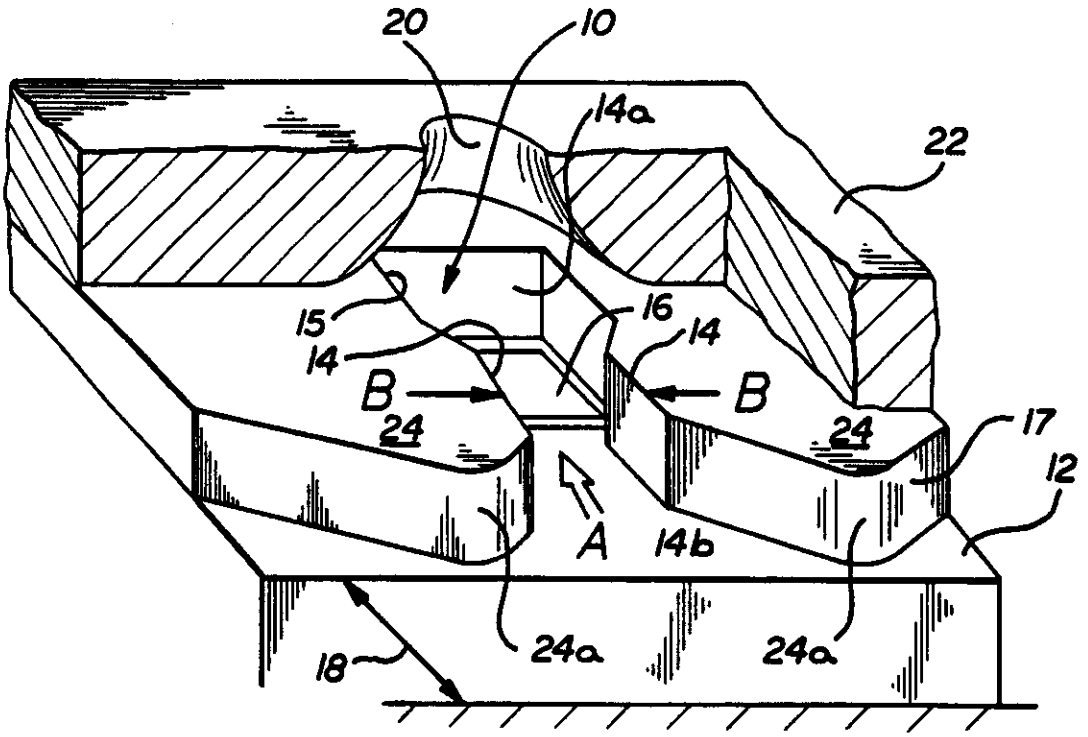


FIG. 1 PRIOR ART

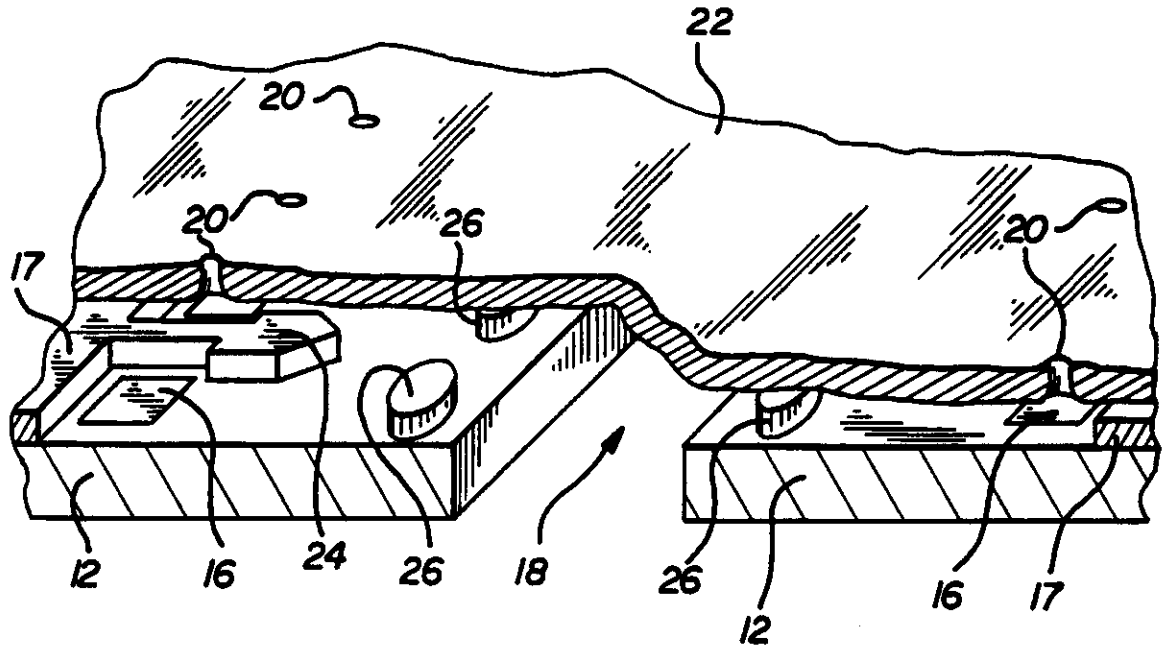


FIG. 2

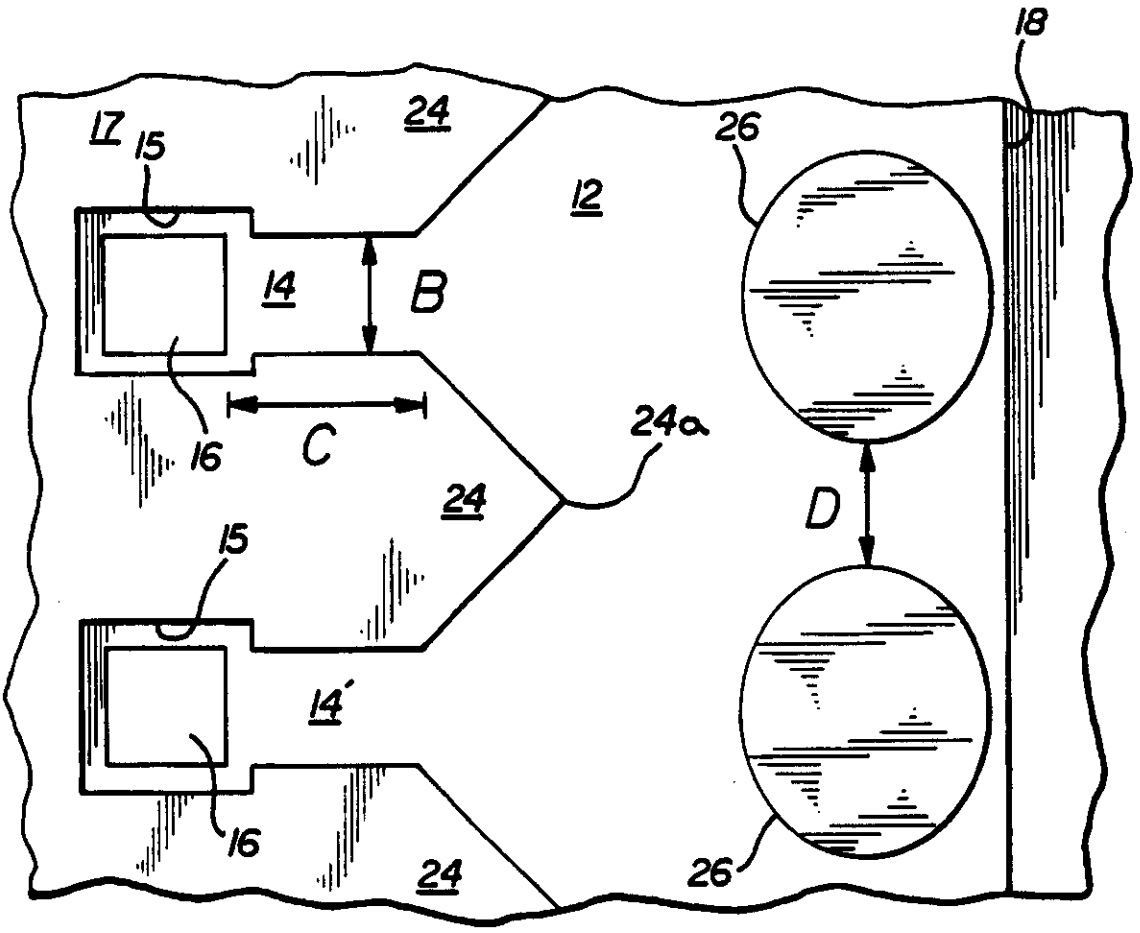


FIG. 3

REGISTER ENTRY FOR EP0627318

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Priority claimed:
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Title INTERNAL SUPPORT FOR TOP-SHOOTER THERMAL INK-JET PRINTHEAD.

Applicant/Proprietor
HEWLETT-PACKARD COMPANY, 3000 Hanover Street, Palo Alto, California 94304, United States of America [ADP No. 50014570004]

Inventors
MAY FONG HO, 4636 Munroe Street, La Mesa, California 91941, United States of America [ADP No. 62483417001]

ELLEN TAPPON, 2511 N.W. Mulkey Avenue, Corvallis, Oregon 97330, United States of America [ADP No. 62483425001]

Classified to
B41J

Address for Service
CARPMAELS & RANSFORD, 43 Bloomsbury Square, LONDON, WC1A 2RA, United Kingdom [ADP No. 00000083001]

EPO Representative
STEPHEN JAMES COLGAN, CARPMAELS & RANSFORD 43 Bloomsbury Square, London WC1A 2RA, United Kingdom [ADP No. 50906551001]

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29.12.1994 Notification from EPO of change of Inventor details from
MAY FONG HO, 4636 Munroe Street, La Mesa, California 91941, United States of America [ADP No. 62483417001]

ELLEN TAPPON, 2511 N.W. Mulkey Avenue, Corvallis, Oregon 97330, United States of America [ADP No. 62483425001]
to
MAY FONG HO, 4555 71st Street, Apt. No. 12, La Mesa, California 91941, United States of America [ADP No. 62667340001]

ELLEN TAPPON, 2511 N.W. Mulkey Avenue, Corvallis, Oregon 97330, United States of America [ADP No. 62483425001]
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RENEWAL DETAILS

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Hewlett-Packard Company, 3000 Hanover Street, Palo Alto, California 94304, United States of America

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DATE NOT IN FORCE

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YEAR OF LAST RENEWAL 00

STATUS PATENT IN FORCE

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