

Description

The invention relates to a method of manufacturing ink jet printheads and, more particularly, to a method of forming tapered orifice arrays in fully assembled ink jet printheads.

A popular form of non-impact printing is generally referred to as ink jet printing. In this technique, ink is forced, most commonly under pressure, through a tiny nozzle to form a droplet. The droplet is electrostatically charged and then attracted towards an oppositely charged platen located behind a sheet paper. Using electrically controlled deflection plates similar to those in a CRT, the trajectory of the droplet can be controlled to hit a desired spot on the paper. Unused drops are deflected away from the paper into a reservoir for recycling of the ink. Due to the small size of the droplet and the precise trajectory control, ink jet printing quality can approach that of formed-character impact printing.

Most commonly, prior ink jet printheads include a body portion having a plurality of ink-carrying channels formed therein for the ejection of ink droplets therefrom. A pressure pulse is then generated in the ink-filled channel. For example, a wall of the channel may be mechanically deflected to compress or expand the size of the channel. The resultant pressure wave would then cause the ejection of a droplet from the front end of the channel.

Many ink jet printheads also include a cover plate fixedly mounted on the front end of the body portion. Extending through the cover plate would be a plurality of orifices which comprise the orifice array for the ink jet printhead. In most ink jet printheads, each orifice in the orifice array corresponds to one of the channels extending through the body portion. The cover plate is positioned on the front end of the body portion such that each orifice is in communication with the corresponding channel. When a pressure wave is created in a channel, the ink droplet is forcedly ejected from the ink jet printhead through the orifice in communication with that channel. While many of such orifices are formed in a generally cylindrical shape, they are often tapered so that the speed and/or directional control of the droplet being ejected may be affected by the orifice shape. For example, by inwardly tapering the orifice by narrowing the circumference of the orifice as it extends from the back side of the cover plate (the side mounted to the front end of the body portion) towards the front side of the cover plate where the ink droplets are ejected, the speed and stability of the ink droplets could be increased during the ejection process.

In order to form a tapered orifice array for an ink jet printhead, it was common to take the unattached cover plate and to drill a series of orifices

therethrough, for example, utilizing conventional laser drilling techniques. As an orifice drilled utilizing conventional laser technology tends to inwardly taper as it is extended through a layer of material, it was possible to produce an orifice array comprised of a series of orifices which would taper inwardly with respect to the flow of ink outwardly therefrom by drilling a series of orifices in the back side of the unattached cover plate. Once drilling of the orifices was completed, a coating of an adhesive material, for example, epoxy, was placed on the back surface of the cover and/or the front end of the main body of the ink jet printhead. The cover would then be aligned with the front end of the main body so that each tapered orifice was located in front of and in communication with a corresponding channel extending through the main body of the ink jet printhead. After alignment of the cover plate and main body was completed, the cover would then be bonded to the front end of the main body of the ink jet printhead.

A significant problem in manufacturing ink jet printheads in this manner was that the adhesive typically used to bond the back side of the cover plate to the front end of the main body of the ink jet printhead tends to clog or partially dock the orifices forced in the cover plate. This problem has become of particular concern in view of the increasing popularity of higher density ink jet printheads, i.e. ink jet printheads having a channel array where adjacent channels are spaced between approximately four and eight mils apart. In such high density ink jet printheads, the likelihood that the cover plate could be mounted on the main body of the ink jet printhead without having the adhesive clogging or partially docking at least one of the tapered orifices formed in the cover plate has become increasingly more unlikely. This problem has significantly complicated present methods for manufacturing ink jet printheads, particularly those having an orifice array comprised of inwardly tapered orifices.

EP-A-0309146 discloses an orifice forming method employing a single laser beam to form ink jet printhead orifices in ablatable material.

According to the present invention there is provided a method of forming an orifice for an ink jet printhead comprising the steps of:

providing a main body portion and a cover plate for an ink jet printhead, the main body portion having a front side and an ink-carrying channel axially extending therethrough for the ejection of ink from the front side thereof, the cover plate formed from an ablatable material and having front and back sides;

mounting the back side of the cover plate onto the front side of the ink jet printhead body, the cover plate covering the ink-carrying channel;

generating first and second light beams capable of ablating the material used to form the cover plate;

forming an ink-carrying channel communicating orifice extending through the cover plate and tapering outwardly from the front side of the cover plate to the back side of the cover plate by directing the first and second light beams at the front side of the cover plate at first and second angles, respectively, such that the first and second light beams form the outwardly tapered orifice in communication with the ink carrying channel.

In one aspect of this embodiment of the invention, the outwardly tapered orifice is formed by directing the first and second light beams at a primary reflecting surface, reflecting the first and second light beams at first and second secondary reflecting surfaces, respectively, reflecting the first light beam reflected to the first secondary reflecting surface at a specified location on the front side of the cover plate, and reflecting the second light beam reflected to the second secondary reflecting surface at the specified location. In another aspect of this embodiment of the invention, the outwardly tapered orifice is formed having a height which increases from the front side of the cover plate to the back side of the cover plate. In yet another aspect of this embodiment of the invention, the outwardly tapered orifice is formed to have a first opening at the front side of the cover plate and first and second openings in communication with the ink-carrying channel at the back side of the cover plate. In still yet another aspect of this embodiment of the invention, the width and/or height of the orifice at the back side of the cover plate may be varied, either by selecting the thickness of the cover plate or by selecting the angle at which the light beam is directed at the cover plate.

In another embodiment, the present invention is of a method of forming a tapered orifice in an assembled ink jet printhead. First and second light beams capable of ablating material used to form the cover plate are generated and directed at a selected location on the front side of the cover plate at respective angles such that the first and second light beams ablate an ink-carrying channel communicating orifice extending through the cover plate and tapering outwardly therethrough.

In yet another embodiment, the present invention is of a method of forming an orifice array for an ink jet printhead. An ink jet printhead body having a front side and a plurality of ink-carrying channels axially extending therethrough is provided. A cover plate to be mounted onto the front side of the ink jet printhead body is selected based upon the desired size of the orifices at the inner side of the cover plate and then mounted onto the front side of the ink jet printhead body to cover the

ink-carrying channels. For each orifice to be formed as part of the orifice array, first and second cover plate ablating light beams are generated and directed, at first and second angles, respectively, at specified locations on the front side of the cover plate which correspond to selected ones of the ink-carrying channels to form ink-carrying channel communicating orifices extending through the cover plate, tapering outwardly therethrough and in respective communication with the selected ones of the ink-carrying channels. In one aspect of this embodiment of the invention, a filter is selected based upon the number and location of orifices forming the orifice array and the cover plate ablating light is directed towards the filter such that the cover plate ablating light beam which will form the orifice array of outwardly tapered orifices pass therethrough.

The present invention may be better understood, and its numerous objects, features and advantages will become apparent to those skilled in the art by reference to the accompanying drawing, in which:

FIG. 1 is a perspective view of an ink jet printhead constructed in accordance with the teachings of the present invention;

FIG. 2 is a partial cross-sectional view of the ink jet printhead of FIG. 1 taken along lines 2-2 and illustrating a parallel channel and orifice of the ink jet printhead of FIG. 1;

FIG. 3 is a schematic view of a laser ablation system for manufacturing the ink jet printhead of FIGS. 1-2;

FIG. 4a is a cross-sectional view of a first tapered orifice which may be formed in the cover of the ink jet printhead of FIGS. 1-2 using the laser ablation system of FIG. 3;

FIG. 4b is a cross-sectional view of a second tapered orifice which may be formed in the cover of the ink jet printhead of FIGS. 1-2 using the laser ablation system of FIG. 3; and

FIG. 4c is a cross-sectional view of a third tapered orifice which may be formed in the cover of the ink jet printhead of FIGS. 1-2 using the laser ablation system of FIG. 3.

Referring first to FIG. 1, an ink jet printhead 10 constructed in accordance with the teachings of the present invention may now be seen. As illustrated herein, the ink jet printhead 10 includes a main body portion 12 having a plurality of ink carrying channels (not visible in FIG. 1) axially extending therethrough. Typically, each of the ink carrying channels extend from a first end located within the main body 12 and terminate at an opening along a front side 12a of the main body portion 12. Preferably, the ink carrying channels should be generally parallel to each other along their entire length. Notwithstanding the specific configuration of the ink jet

printhead 10 described and illustrated herein, it is fully contemplated that the method of forming a tapered orifice array in a fully assembled ink jet printhead which is the subject of the present invention is readily applicable to numerous other ink jet printhead configurations. Specifically, it is contemplated that the present invention may be used in combination with those configurations of the ink jet printhead 10 where the main body portion 12 of the ink jet printhead 10 is formed of a single piece of material, either active or inactive, or formed of any number of components, again, either active or inactive, bonded together to form the main body portion 12. It is further contemplated that the present invention may be used to form a single tapered orifice in an ink jet printhead having a single ink-carrying channel axially extending therethrough.

Ink is supplied to the ink-carrying channels from an ink supply means 13 via an external conduit 15. Many methods for supplying ink from the ink supply means to the ink-carrying channels are known in the art and, therefore, need not be described in greater detail here. For example, for the ink jet printhead 10, the external conduit 15 delivers the ink to a vertically orientated internal conduit (not shown) which, in turn, supplies the ink to a manifold (also not shown) extending lengthwise in the interior of the ink jet printhead 10. As the manifold is in communication with each of the parallel ink-carrying channels, ink may be drawn into the ink-carrying channels from the manifold.

Continuing to refer to FIG. 1, the ink jet printhead 10 further includes a cover plate 14 having a back side 14a, a front side 14b and a plurality of tapered orifices 16 extending therethrough. Preferably, the cover plate 14 should be formed of polyimide or another suitable material. The back side 14a is aligned, mated and bonded with the main body portion 12 such that each tapered orifice 16 is in communication with a corresponding one of the plurality of channels formed in the main body portion 12. Regarding the taper of the orifices 16, the orifices 16 may be considered to be "inwardly" tapered from the back side 14a of the cover plate 14 where the orifices 16 communicate with the corresponding one of the ink-carrying channels to the front side 14b of the cover plate 14 from where the ink droplets are ejected. Alternatively, the orifices 16 may be considered to be "outwardly" tapered from the front side 14b of the cover plate 14 where the light beam drills the orifices 16 to the back side 14a of the cover plate 14 where the orifices 16 communicate with the corresponding one of the ink-carrying channels. Preferably, each tapered orifice 16 should be positioned such that it is located at the center of the end of the corresponding channel, thereby providing ink ejection nozzles for the channels. It is

contemplated that the dimensions of the orifice array 17 comprised of the tapered orifices 16 could be varied to cover various selected lengths along the cover plate 14, depending on the channel requirements of the particular ink jet printhead 10 envisioned. For example, the orifice array 17 may extend about 0.193 inches along the front side 14b of the cover plate 14 and be comprised of about twenty-eight orifices 16 provided in a single row.

Referring next to FIG. 2, a tapered orifice 16 in communication with an ink-carrying channel 22 may now be seen. The tapered orifice 16 convergently extends from an entry aperture 18 of a first height located at the back side 14a of the cover plate 14 to an exit aperture 20 of a second, lesser, height located at the front side 14b of the cover plate 14. The tapered orifice 16 communicates with a front end 23 of a corresponding ink-carrying channel 22 at the entry aperture 18. Thus, when a ink ejecting pressure pulse is applied to the channel 22, a droplet of ink would be forced out the front end 23 of the ink-carrying channel 22 through the inwardly tapered orifice 16, where its velocity would be increased, and ejected from the ink jet printhead 10 at the exit aperture 20.

Referring next to FIG. 3, the method of manufacturing an ink jet printhead having a single tapered orifice or an array of tapered orifices such as those illustrated in FIG. 1-2 using laser ablation optics shall now be described. To form an orifice 16 in an ink jet printhead 10' having a single ink-carrying channel 22' formed therein or an orifice array 17 in the ink jet printhead 10 having multiple ink-carrying channels 22 formed therein, a orifice-less cover 14' is first mounted onto a main body portion 12' of the ink jet printhead 10', most commonly, using an adhesive such as an epoxy, or other conventional mounting means, to cover the ink-carrying channel 22'. Next, a tapered orifice is formed, preferably in the approximate center of the ink-carrying channel 22' using a laser. Specifically, a laser 24 generates a coherent beam of UV light which passes through a mask chamber 26. Within the mask chamber 26 is a mask 27 for modifying the generated light beam so that it will pattern the location of the desired orifice or orifice array 17. The mask 27 may be comprised of a thin sheet of metal having a series of apertures (not shown) formed in an array which patterns the desired shape of the orifice array 17. Alternately, the mask 27 may be comprised of a sheet of glass having a thin film formed thereon which covers the entire sheet with the exception of particular locations which pattern the desired locations of the orifices 16 of the orifice array 17.

The generated coherent UV light passes through the apertures in the mask 27 and are then reflected off a primary reflecting surface 28 to-

wards first and second secondary reflecting surfaces 30 and 32. For example, in FIG. 3, two beams of coherent light are illustrated emerging from the mask 27 along paths a_1 , b_1 , respectively. The beams travelling along paths a_1 , b_1 , are reflected off the primary reflecting surface 28 and directed towards the first and second secondary reflecting surfaces 30, 32, respectively, along paths a_2 and b_2 . The first secondary reflecting surface 30 and the second secondary reflecting surface 32 are positioned relative to the orificeless cover plate 14' such that the beams travelling along paths a_2 , b_2 are directed along paths a_3 , b_3 at a selected location on a front side 14b' of the orificeless cover plate 14' where the beam converge, typically at equal but opposite angles to each other, at the selected location on the front side 14b' to drill a tapered orifice in the orificeless cover plate 14'. Of course, the mask 27 may be readily modified so that additional beams of light may emerge therefrom to drill additional tapered orifices in the orificeless cover 14' and the first and second reflecting surfaces 30, 32 may alternately be positioned such that the beams directed at the selected location, as well as the orifice formed by the beam, will elongate in both axes or will elongate in one axis, for example, height, and will not elongate in a second axis, for example, width. It is further contemplated that, in one embodiment of the invention, the mask 27 may be configured such that the beam of coherent light entering the mask 27 will emerge as a beam directed at the selected location and shaped such that it will drill a tapered orifice at the selected location on the front side 14b' of the orificeless cover plate 14'. Finally, it should be noted that while the embodiment of the invention described with respect to FIG. 3 is directed to a method of forming a tapered orifice array in a cover plate mounted to an ink jet printhead, it is specifically contemplated that, in accordance with one embodiment of the invention, tapered orifices extending outwardly from the front to back sides of the cover plate may be formed on an unmounted cover plate by directing cover plate ablating light onto the front surface of the unmounted cover plate in a manner identical to that described above.

Referring next to FIGS. 4a-4c, various configurations of each tapered orifice 16 may now be seen. Specifically, it may be seen that the width of the inner aperture 18 of the tapered orifice 16, as well as the number of inner apertures 18 per tapered orifice 16, may be controlled by modifying the thickness of the orificeless cover plate 14' since, as the thickness of the orificeless cover plate 14' is increased, the cover plate ablating beam continues to spread out along its elongated axis, thereby widening the taper of the orifice. It is further contemplated, however, that the width of the inner

aperture 18 of the tapered orifice 16, as well as the angle of taper for the tapered orifice 16, may be modified, for example, by repositioning the first and secondary reflecting surfaces, by adjusting the angle at which the cover plate ablating beams converge at the orificeless cover plate 14'.

Referring specifically to FIG. 4a, an approximately one mil orificeless cover plate 14' was selected, thereby producing an inwardly tapered orifice 18 extending through the cover plate 14' from the back side 14a' towards the front side 14b' of the cover plate 14' in which the inner aperture 18a is approximately 2.5 to 3 times wider than the exit aperture 20a. Referring next to FIG. 4b, an approximately 2 mil thick orificeless cover plate 14' was utilized to produce an inwardly tapering orifice in which the inner aperture 18b is approximately 5 to 6 times the width of the outer aperture 20b. Finally, in FIG. 4c, an approximately 3 mil thick orificeless cover plate 14' was utilized to produce a tapered orifice having a single aperture and a pair of inner apertures 18c, 18d and a single outer aperture 20c. Here, all three apertures 18c, 18d and 20c have approximately the same diameter.

Thus, there has been described and illustrated herein a method for producing tapered orifice arrays in fully assembled ink jet printheads in which orifices tapered inwardly with respect to the direction of droplet ejection may be formed after assembly of an orificeless ink jet printhead, thereby providing an improved method of assembling ink jet printheads which avoids the possibility of inadvertently partially blocking channel orifices with adhesive during the final assembly step.

Claims

1. A method of forming an orifice (16) for an ink jet printhead (10) comprising the steps of:

providing a main body portion (12) and a cover plate (14) for an ink jet printhead, the main body portion having a front side (12a) and an ink-carrying channel (22) axially extending therethrough for the ejection of ink from the front side thereof, the cover plate formed from an ablatable material and having front and back sides;

mounting the back side of the cover plate onto the front side of the ink jet printhead body, the cover plate covering the ink-carrying channel;

generating first and second light beams capable of ablating the material used to form the cover plate;

forming an ink-carrying channel communicating orifice extending through the cover plate and tapering outwardly from the front side of the cover plate to the back side of the



wards first and second secondary reflecting surfaces 30 and 32. For example, in FIG. 3, two beams of coherent light are illustrated emerging from the mask 27 along paths a_1 , b_1 , respectively. The beams travelling along paths a_1 , b_1 , are reflected off the primary reflecting surface 28 and directed towards the first and second secondary reflecting surfaces 30, 32, respectively, along paths a_2 and b_2 . The first secondary reflecting surface 30 and the second secondary reflecting surface 32 are positioned relative to the orificeless cover plate 14' such that the beams travelling along paths a_2 , b_2 are directed along paths a_3 , b_3 at a selected location on a front side 14b' of the orificeless cover plate 14' where the beam converge, typically at equal but opposite angles to each other, at the selected location on the front side 14b' to drill a tapered orifice in the orificeless cover plate 14'. Of course, the mask 27 may be readily modified so that additional beams of light may emerge therefrom to drill additional tapered orifices in the orificeless cover 14' and the first and second reflecting surfaces 30, 32 may alternately be positioned such that the beams directed at the selected location, as well as the orifice formed by the beam, will elongate in both axes or will elongate in one axis, for example, height, and will not elongate in a second axis, for example, width. It is further contemplated that, in one embodiment of the invention, the mask 27 may be configured such that the beam of coherent light entering the mask 27 will emerge as a beam directed at the selected location and shaped such that it will drill a tapered orifice at the selected location on the front side 14b' of the orificeless cover plate 14'. Finally, it should be noted that while the embodiment of the invention described with respect to FIG. 3 is directed to a method of forming a tapered orifice array in a cover plate mounted to an ink jet printhead, it is specifically contemplated that, in accordance with one embodiment of the invention, tapered orifices extending outwardly from the front to back sides of the cover plate may be formed on an unmounted cover plate by directing cover plate ablating light onto the front surface of the unmounted cover plate in a manner identical to that described above.

Referring next to FIGS. 4a-4c, various configurations of each tapered orifice 16 may now be seen. Specifically, it may be seen that the width of the inner aperture 18 of the tapered orifice 16, as well as the number of inner apertures 18 per tapered orifice 16, may be controlled by modifying the thickness of the orificeless cover plate 14' since, as the thickness of the orificeless cover plate 14' is increased, the cover plate ablating beam continues to spread out along its elongated axis, thereby widening the taper of the orifice. It is further contemplated, however, that the width of the inner

aperture 18 of the tapered orifice 16, as well as the angle of taper for the tapered orifice 16, may be modified, for example, by repositioning the first and secondary reflecting surfaces, by adjusting the angle at which the cover plate ablating beams converge at the orificeless cover plate 14'.

Referring specifically to FIG. 4a, an approximately one mil orificeless cover plate 14' was selected, thereby producing an inwardly tapered orifice 18 extending through the cover plate 14' from the back side 14a' towards the front side 14b' of the cover plate 14' in which the inner aperture 18a is approximately 2.5 to 3 times wider than the exit aperture 20a. Referring next to FIG. 4b, an approximately 2 mil thick orificeless cover plate 14' was utilized to produce an inwardly tapering orifice in which the inner aperture 18b is approximately 5 to 6 times the width of the outer aperture 20b. Finally, in FIG. 4c, an approximately 3 mil thick orificeless cover plate 14' was utilized to produce a tapered orifice having a single aperture and a pair of inner apertures 18c, 18d and a single outer aperture 20c. Here, all three apertures 18c, 18d and 20c have approximately the same diameter.

Thus, there has been described and illustrated herein a method for producing tapered orifice arrays in fully assembled ink jet printheads in which orifices tapered inwardly with respect to the direction of droplet ejection may be formed after assembly of an orificeless ink jet printhead, thereby providing an improved method of assembling ink jet printheads which avoids the possibility of inadvertently partially blocking channel orifices with adhesive during the final assembly step.

Claims

1. A method of forming an orifice (16) for an ink jet printhead (10) comprising the steps of:
 - providing a main body portion (12) and a cover plate (14) for an ink jet printhead, the main body portion having a front side (12a) and an ink-carrying channel (22) axially extending therethrough for the ejection of ink from the front side thereof, the cover plate formed from an ablatable material and having front and back sides;
 - mounting the back side of the cover plate onto the front side of the ink jet printhead body, the cover plate covering the ink-carrying channel;
 - generating first and second light beams capable of ablating the material used to form the cover plate;
 - forming an ink-carrying channel communicating orifice extending through the cover plate and tapering outwardly from the front side of the cover plate to the back side of the



- cover plate by directing the first and second light beams at the front side of the cover plate at first and second angles, respectively, such that the first and second light beams form the outwardly tapered orifice in communication with the ink carrying channel.
2. A method according to claim 1 wherein the step of forming an outwardly tapered orifice (16) further comprises the step of forming an orifice having a height which increases from the front side of the cover plate (14) to the back side of the cover plate.
 3. A method according to claim 1 wherein the step of forming an outwardly tapered orifice (16) further comprises the step of forming an orifice having a first opening at the front side of the cover plate (14) and first and second openings in communication with the ink-carrying channel (22) at the back side of the cover plate (14).
 4. A method according to claim 1 and further comprising the step of varying the width and/or height of the orifice (16) at the back side of the cover plate (14).
 5. A method according to claim 4, wherein the step of varying the width of the orifice (16) at the back side of the cover plate (14) further comprises the step of forming a cover plate having a selected thickness based upon the desired width of the orifice at the back side of the cover plate.
 6. A method according to claim 4, wherein the step of varying the width of the orifice (16) at the back side of the cover plate (14) further comprises the step of directing the first and second light beams at the cover plate at first and second angles selected based upon the desired width of the orifice at the back side of the cover plate.
 7. A method according to claim 1 wherein the step of forming an ink-carrying channel communicating orifice (16) extending through the cover plate (14) and tapering outwardly from the front side of the cover plate to the back side of the cover plate by directing the first and second light beams at the front side of the cover plate at first and second angles, respectively, such that the first and second light beams form the outwardly tapered orifice in communication with the ink-carrying channel (22) further comprises the steps of:
 - directing the first and second light beams at a primary reflecting surface (28);
 - reflecting the first and second light beams at first and second (32) second reflecting surfaces, respectively;
 - reflecting the first light beam reflected to the first secondary reflecting surface at a specified location on the front side of the cover plate; and
 - reflecting the second light beam reflected to the second secondary reflecting surface at the specified location;
 - wherein the first and second light beams reflected at the specified location ablate the cover plate material to form the outwardly tapered orifice in communication with the ink-carrying channel (22).
 8. A method according to claim 1 wherein the step of forming an ink-carrying channel communicating orifice (16) extending through the cover plate (14) and tapering outwardly from the front side of the cover plate to the back side of the cover plate by directing the first and second light beams at the front side of the cover plate at first and second angles, respectively, such that the first and second light beams form the outwardly tapered orifice in communication with the ink-carrying channel further comprises the step of shaping the generated light beam to ablate the outwardly tapering orifice when directed at the front side of the cover plate.
 9. A method according to any of the preceding claims, wherein a plurality of orifices (16) are formed, and first and second beams are generated for each orifice.
 10. A method according to claim 9, wherein the method includes the prior steps of: selecting a cover plate to be mounted onto the front side of the ink jet printhead body (44) based upon the desired size of the orifices (16) at the inner side of the cover plate; and,
 - mounting the cover plate onto the front side of the ink jet printhead body to cover the ink-carrying channels (22).
 11. A method according to claim 10, further comprising the steps of:
 - selecting a filter (26) based upon the number and location of orifices (14) forming the orifice array; and
 - directing the cover plate ablating light towards the filter, the filter passing cover plate ablating light beams for forming the orifice array of outwardly tapered orifices.



Patentansprüche

1. Verfahren zum Herstellen einer Öffnung (16) für einen Tintenstrahldruckkopf (10), das die folgenden Schritte umfaßt:
 Bereitstellen eines Hauptkörperabschnitts (12) und einer Abdeckplatte (14) für einen Tintenstrahldruckkopf, wobei der Hauptkörperabschnitt eine Vorderseite (12a) und einen Tintenleitkanal (22) aufweist, der axial durch selbigen hindurch verläuft und dem Ausstoßen von Tinte von der Vorderseite desselben aus dient, wobei die Abdeckplatte aus einem abschmelzbaren Material besteht und eine Vorder- und eine Rückseite aufweist;
 Anbringen der Rückseite der Abdeckplatte an der Vorderseite des Tintenstrahldruckkopfkörpers, wobei die Abdeckplatte den Tintenleitkanal abdeckt;
 Erzeugen eines ersten und eines zweiten Lichtstrahls, die in der Lage sind, das Material abzuschmelzen, das zum Herstellen der Abdeckplatte eingesetzt wird;
 Herstellen einer mit dem Tintenleitkanal in Verbindung stehenden Öffnung, die sich durch die Abdeckplatte hindurch erstreckt und von der Vorderseite der Abdeckplatte zur Rückseite der Abdeckplatte konisch nach außen verläuft, indem der erste und der zweite Lichtstrahl so in einem ersten bzw. einem zweiten Winkel auf die Vorderseite der Abdeckplatte gerichtet werden, daß der erste und der zweite Lichtstrahl die konisch nach außen verlaufende Öffnung herstellen, die mit dem Tintenleitkanal in Verbindung steht.
2. Verfahren nach Anspruch 1, wobei der Schritt des Herstellens einer konisch nach außen verlaufenden Öffnung (16) des weiteren den Schritt des Herstellens einer Öffnung umfaßt, die eine Höhe aufweist, die von der Vorderseite der Abdeckplatte (14) zur Rückseite der Abdeckplatte hin zunimmt.
3. Verfahren nach Anspruch 1, wobei der Schritt des Herstellens einer konisch nach außen verlaufenden Öffnung (16) des weiteren den Schritt des Herstellens einer Öffnung aufweist, die ein erstes Loch an der Vorderseite der Abdeckplatte (14) und ein erstes und ein zweites Loch an der Rückseite der Abdeckplatte (14) aufweist, die mit dem Tintenleitkanal (22) in Verbindung stehen.
4. Verfahren nach Anspruch 1, das des weiteren den Schritt des Änderns der Breite und/oder der Höhe der Öffnung (16) an der Rückseite der Abdeckplatte (14) umfaßt.
5. Verfahren nach Anspruch 4, wobei der Schritt des Änderns der Breite der Öffnung (16) an der Rückseite der Abdeckplatte (14) des weiteren den Schritt des Herstellens einer Abdeckplatte mit einer ausgewählten Dicke auf der Grundlage der gewünschten Breite der Öffnung an der Rückseite der Abdeckplatte umfaßt.
6. Verfahren nach Anspruch 4, wobei der Schritt des Änderns der Breite der Öffnung (16) an der Rückseite der Abdeckplatte (14) des weiteren den Schritt des Richtens des ersten und des zweiten Lichtstrahls auf die Abdeckplatte in einem ersten und einem zweiten Winkel umfaßt, die auf der Grundlage der gewünschten Breite der Öffnung an der Rückseite der Abdeckplatte ausgewählt werden.
7. Verfahren nach Anspruch 1, wobei der Schritt des Herstellens einer mit dem Tintenleitkanal in Verbindung stehenden Öffnung (16), die sich durch die Abdeckplatte (14) hindurch erstreckt und von der Vorderseite der Abdeckplatte zur Rückseite der Abdeckplatte konisch nach außen verläuft, indem der erste und der zweite Lichtstrahl so in einem ersten bzw. einem zweiten Winkel auf die Vorderseite der Abdeckplatte gerichtet werden, daß der erste und der zweite Lichtstrahl die konisch nach außen verlaufende Öffnung herstellen, die mit dem Tintenleitkanal (22) in Verbindung steht, des weiteren die folgenden Schritte umfaßt:
 Richten des ersten und des zweiten Lichtstrahls auf eine Primärreflexionsfläche (28);
 Reflektieren des ersten und des zweiten Lichtstrahls auf eine erste bzw. eine zweite (32) Sekundärreflexionsfläche;
 Reflektieren des ersten Lichtstrahls, der auf die erste Sekundärreflexionsfläche reflektiert wird, an eine bestimmte Stelle an der Vorderseite der Abdeckplatte; und
 Reflektieren des zweiten Lichtstrahls, der auf die zweite Sekundärreflexionsfläche reflektiert wird, an die bestimmte Stelle;
 wobei der erste und der zweite Lichtstrahl, die an die bestimmte Stelle reflektiert werden, das Abdeckplattenmaterial abschmelzen, so daß die konisch nach außen verlaufende Öffnung hergestellt wird, die mit dem Tintenleitkanal (22) in Verbindung steht.
8. Verfahren nach Anspruch 1, wobei der Schritt des Herstellens einer mit dem Tintenleitkanal in Verbindung stehenden Öffnung (16), die sich durch die Abdeckplatte (14) hindurch erstreckt und von der Vorderseite der Abdeckplatte zur Rückseite der Abdeckplatte konisch nach au-



Ben verläuft, indem der erste und der zweite Lichtstrahl so in einem ersten bzw. einem zweiten Winkel auf die Vorderseite der Abdeckplatte gerichtet werden, daß der erste und der zweite Lichtstrahl die konisch nach außen verlaufende Öffnung herstellen, die mit dem Tintenleitkanal in Verbindung steht, des weiteren den Schritt des Formens des erzeugten Lichtstrahls umfaßt, so daß er die konisch nach außen verlaufende Öffnung abschmilzt, wenn er auf die Vorderseite der Abdeckplatte gerichtet wird.

9. Verfahren nach einem der vorangehenden Ansprüche, wobei eine Vielzahl von Öffnungen (16) hergestellt werden, und ein erster und ein zweiter Strahl für jede Öffnung erzeugt werden.

10. Verfahren nach Anspruch 9, wobei das Verfahren die folgenden vorhergehenden Schritte enthält:

Auswählen einer Abdeckplatte, die an der Vorderseite des Tintenstrahldruckkopfkörpers (44) angebracht werden soll, auf der Grundlage der gewünschten Größe der Öffnungen (16) an der Innenseite der Abdeckplatte; und Anbringen der Abdeckplatte an der Vorderseite des Tintenstrahldruckkopfkörpers, so daß die Tintenleitkanäle (22) abgedeckt sind.

11. Verfahren nach Anspruch 10, das des weiteren die folgenden Schritte umfaßt:

Auswählen eines Filters (26) auf der Grundlage der Anzahl und der Anordnung der Öffnungen (14), die die Öffnungsanordnung bilden; und Richten des die Abdeckplatte abschmelzenden Lichts auf das Filter, wobei das Filter die Abdeckplatte abschmelzende Lichtstrahlen durchläßt, um die Öffnungsanordnung von konisch nach außen verlaufenden Öffnungen herzustellen.

Revendications

1. Procédé de formation d'un orifice (16) pour une tête d'impression à jet d'encre (10), comprenant les étapes suivantes :

on part d'une partie de corps principale (12) et d'une plaque de couverture (14) pour une tête d'impression à jet d'encre, la partie de corps principale comportant une face avant (12a) et un canal d'acheminement d'encre (22) s'étendant axialement à travers celle-ci pour l'éjection de l'encre depuis la face avant de celle-ci, la plaque de couverture étant formée en un matériau érodable et comportant des faces avant et arrière ;

on monte la face arrière de la plaque de

couverture sur la face avant du corps de la tête d'impression à jet d'encre, la plaque de couverture couvrant le canal d'acheminement d'encre ;

on génère des premier et deuxième faisceaux de lumière susceptibles d'éroder le matériau utilisé pour former la plaque de couverture .

on forme un orifice de communication avec le canal d'acheminement d'encre s'étendant à travers la plaque de couverture, et s'élargissant de la face avant de la plaque de couverture à la face arrière de la plaque de couverture, en dirigeant les premier et deuxième faisceaux de lumière en face avant de la plaque de couverture selon des premier et deuxième angles, respectivement, de telle sorte que les premier et deuxième faisceaux de lumière forment l'orifice s'élargissant en communication avec le canal d'acheminement d'encre.

2. Procédé selon la revendication 1, dans lequel l'étape de formation d'un orifice s'élargissant (16) comporte de plus l'étape de formation d'un orifice ayant une hauteur qui s'accroît de la face avant de la plaque de couverture (14) à la face arrière de la plaque de couverture.

3. Procédé selon la revendication 1, dans lequel l'étape de formation d'un orifice s'élargissant (16) comporte de plus l'étape de formation d'un orifice ayant une première ouverture en face avant de la plaque de couverture (14) et des première et deuxième ouvertures en communication avec le canal d'acheminement d'encre (22) en face arrière de la plaque de couverture (14).

4. Procédé selon la revendication 1, comportant de plus l'étape consistant à faire varier la largeur et/ou la hauteur de l'orifice (16) en face arrière de la plaque de couverture (14).

5. Procédé selon la revendication 4, dans lequel l'étape consistant à faire varier la largeur de l'orifice (16) en face arrière de la plaque de couverture (14) comporte de plus l'étape consistant à former une plaque de couverture ayant une épaisseur sélectionnée en fonction de la largeur désirée de l'orifice en face arrière de la plaque de couverture.

6. Procédé selon la revendication 4, dans lequel l'étape consistant à faire varier la largeur de l'orifice (16) en face arrière de la plaque de couverture (14) comporte de plus l'étape consistant à diriger les premier et deuxième



faisceaux de lumière au niveau de la plaque de couverture selon des premier et deuxième angles sélectionnés en fonction de la largeur désirée de l'orifice en face arrière de la plaque de couverture.

7. Procédé selon la revendication 1, dans lequel l'étape consistant à former un orifice (16) de communication avec le canal d'acheminement d'encre, s'étendant à travers la plaque de couverture (14) et s'élargissant de la face avant de la plaque de couverture à la face arrière de la plaque de couverture, en dirigeant les premier et deuxième faisceaux de lumière en face avant de la plaque de couverture selon des premier et deuxième angles, respectivement, de telle sorte que les premier et deuxième faisceaux de lumière forment l'orifice s'élargissant en communication avec le canal d'acheminement d'encre (22), comprend de plus les étapes suivantes :

on dirige les premier et deuxième faisceaux de lumière sur une surface réfléchissante primaire (28);

on fait se réfléchir les premier et deuxième faisceaux de lumière vers des première et deuxième (32) surfaces réfléchissantes secondaires, respectivement ;

on fait se réfléchir le premier faisceau de lumière, réfléchi vers la première surface réfléchissante secondaire, vers un emplacement spécifié sur la face avant de la plaque de couverture ; et

on fait se réfléchir le deuxième faisceau de lumière, réfléchi vers la deuxième surface réfléchissante secondaire, vers l'emplacement spécifié ;

dans lequel les premier et deuxième faisceaux de lumière réfléchis vers l'emplacement spécifié érodent le matériau de la plaque de couverture de façon à former l'orifice s'élargissant en communication avec le canal d'acheminement d'encre (22).

8. Procédé selon la revendication 1, dans lequel l'étape de formation d'un orifice (16) de communication avec le canal d'acheminement d'encre s'étendant à travers la plaque de couverture (14) et s'élargissant de la face avant de la plaque de couverture à la face arrière de la plaque de couverture en dirigeant les premier et deuxième faisceaux de lumière en face avant de la plaque de couverture selon des premier et deuxième angles, respectivement, de telle sorte que les premier et deuxième faisceaux de lumière forment l'orifice s'élargissant en communication avec le canal d'acheminement d'encre, comporte de plus l'étape

consistant à mettre en forme le faisceau de lumière généré de telle sorte qu'il érode l'orifice s'élargissant lorsqu'il est dirigé en face avant de la plaque de couverture.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel une pluralité d'orifices (16) sont formés, et des premier et deuxième faisceaux sont générés pour chaque orifice.

10. Procédé selon la revendication 9, dans lequel le procédé comporte les étapes préalables suivantes :

on sélectionne une plaque de couverture devant être montée sur la face avant du corps de tête d'impression à jet d'encre (44) en fonction de la taille désirée des orifices (16) sur la face intérieure de la plaque de couverture ; et

on monte la plaque de couverture sur la face avant du corps de la tête d'impression à jet d'encre afin de couvrir les canaux d'acheminement d'encre (22).

11. Procédé selon la revendication 10, comportant de plus les étapes suivantes :

on sélectionne un filtre (26) en fonction du nombre et de l'emplacement des orifices (14) formant le groupement d'orifices ; et

on dirige la lumière d'érosion de la plaque de couverture vers le filtre, le filtre permettant le passage des faisceaux de lumière d'érosion de la plaque de couverture pour former le groupement d'orifices constitué par des orifices s'élargissant.