

Description

This invention relates to an ink jet recording head that forms an image on a recording medium by ejecting ink droplets.

To achieve high quality printing with on-demand type ink jet recording apparatuses, it is necessary to increase their nozzle density. To this end, the specifications of U.S. Patent Nos. 4680595 and 4611219, or Japanese Patent Laid-Open Publication No. 172 1981 propose ink jet recording heads that are constructed so that an array of nozzles formed on a common substrate is interposed by a group of pressure chambers so as to cause each pressure chamber to face each nozzle to thereby form a high density nozzle structure. These ink jet recording heads have a U-shaped ink preparation chamber which is arranged so as to not only surround one end of the group of pressure chambers but also to communicate with each of them.

However, in such a head structure, the U-shaped ink preparation chamber has a dead end. Once air bubbles are admitted into the ink preparation or supply chamber and remain in the dead end, it is difficult to purge them out. Also, with the U-shaped ink preparation chamber, the ink supply capacity differs between pressure chambers and this causes inconsistency in ink ejection characteristics such as the ink droplet diameter and ink ejection rate, thus presenting the problem of deteriorating the printing quality of the head.

Document JP-A.63 280 649 shows an ink jet head in which a 3 x 7 array of pressure chambers may be surrounded by an annular ink chamber.

The present invention has as object the provision of an ink jet recording head in which a constricted portion of an ink supply path that communicates with a pressure chamber is manufactured with ease and with high accuracy.

This object is solved by the ink jet recording head according to independent claim 1. Further advantageous features of this ink jet recording head are evident from the dependent claims, the following description, and the drawings.

The ink jet recording head according to the present invention comprises: a head substrate; at least a group of pressure chambers arranged so as to be recessed over an entire surface of the head substrate; ink ejecting nozzles, each of which is opened so as to face a surface opposite to that of the substrate by extending through a flow path that passes through the head substrate thicknesswise from one end of each of the pressure chambers said flow path having a constricted portion; an ink preparation chamber communicating with the other end of each of the pressure chambers; the head substrate, including the series of flow paths, pressure chambers, and ink chambers being formed by

injection moulding a high molecular weight resin; and the constricted portion being machined using a laser beam.

Fig. 1 is a plan view of an ink jet recording head according to the present invention; and

Fig. 2 is a sectional view taken along the line E-E of Fig. 1.

Figs. 1 and 2 are a plan view and a sectional view, respectively, showing a flow path structure of an ink jet recording head according to the present invention. A head substrate 1 is formed by injection moulding a high molecular weight resin such as polysulfone, polyether sulfone, or polycarbonate, or by photoetching a piece of glass. The actual ink flow path is completed by bonding a vibrating plate 8 made of the same material as the head substrate on the flow path groove formed surface of the head substrate using a solvent such as triethylene glycol dibutylether.

On the vibrating plate 8 is an electrode formed of either a metal plate or a metal film such as an indium-tin oxide film (ITO film) to provide a common electrode. A piezoelectric element is bonded to the electrode in a position corresponding to the pressure chamber. Additional features including a signal line, an ink supply pipe, and a head cover are assembled to form the entire ink jet recording head.

The vibrating plates 8 shown in Fig. 2 are omitted in Fig. 1.

In the invention, an ink preparation chamber 4 communicating with pressure chambers 2 is arranged on a surface opposite to the surface of a head substrate 1 on which the pressure chambers 2 are formed. Each of the pressure chambers 2 communicates with the ink preparation chamber 4 through a supply path 14 that passes through the head substrate 1 thicknesswise from one end 2b of the pressure chamber(s), and constricted portion(s) 3. The ink preparation chamber 4 is formed so as to overlap the pressure chambers 2 as shown by a broken line in Fig. 1. This makes it possible to reduce the width of the head, which in turn allows a sheet forwarding roller to be located near the row of ink ejecting nozzles. Thus, the printing area in the recording sheet can be increased.

In the present invention, each supply path 14 has its circular hole injection-formed and its constricted portion 3 machined using a laser beam. Accordingly, it is not required that these tiny constricted portions be injection-formed, thus resulting in an easier and accurate forming process. In addition, because the constricted portions are not bonded to the vibrating plate 8, each constricted portion is unlikely to collapse.

Furthermore, in the invention of Figs. 1 and 2, the ink supply pipe 9 is connected on one side of the group of pressure chambers. Such an arrange-

ment gives the head no portion projecting in the sheet forwarding direction and, as a result, the head does not touch the recording sheet curled by the swelling of the ink after printing, thereby preventing the contamination of the recording sheet by the ink.

Accordingly to a second embodiment of the present invention, the ink preparation chamber that communicates with each of the pressure chambers is arranged so as to be annular, thereby improving the air bubble discharging characteristics and preventing disruption of ink injection. In addition, the advantage that the ink can be supplied to each of the ink ejection nozzles uniformly ensures excellent printing quality.

Claims

1. An ink jet recording head, comprising:
a generally planar head substrate (1);
a plurality of pressure chambers (2) recessed into a first surface of said substrate; and
an equal plurality of ink ejecting nozzles (7), each of which opens at a second, opposite surface of said substrate (1) through a flow path (5) that passes through said substrate and openly communicates with one end (2a) of an associated pressure chamber (2); and characterized in further comprising;
an ink chamber (4) arranged in a position which is on the second surface of said head substrate (1), said ink chamber (4) communicating with another end of each of said pressure chambers (2) through a flow path (14) that passes through said head substrate (1) thicknesswise, said flow path (14) having a constricted portion (3),
said head substrate (1) with a series of ink paths including said pressure chambers (2), said ink chamber (4) being formed by injection molding a high molecular weight resin; and
said constricted portion (3) of said flow path (14) being machined using a laser beam.
2. An ink jet recording head according to claim 1, wherein said ink chamber (4) is annular and surrounds said plurality of pressure chambers (2).
3. An ink jet recording head according to claims 1 or 2, wherein said ink chamber is arranged in a position which is on a second surface of said head substrate (1) and which overlaps at least a part of said pressure chamber (2).
4. An ink jet recording head according to one of the preceding claims, wherein said ink chamber (4) has a smooth shape with no corners.
5. An ink jet recording head according to one of claims 1 to 4, wherein plates (8) made of the same material as said head substrate are bonded over said group of pressure chambers (2).

Patentansprüche

1. Tintenstrahlaufzeichnungskopf mit:
einem im allgemeinen planaren Kopfsubstrat (1);
einer Vielzahl von in einer ersten Oberfläche des Substrats eingelassenen Druckkammern (2); und
einer gleichen Vielzahl von Tintenausstoßdüsen (7), von denen sich jede an einer zweiten gegenüberliegenden Oberfläche des Substrats (1) über einen Durchflußweg (5) öffnet, welcher sich durch das Substrat hindurch erstreckt und offen mit einem Ende (2a) einer zugeordneten Druckkammer (2) in Verbindung steht; dadurch gekennzeichnet, daß er des weiteren aufweist:
eine Tintenkammer (4), die in einer Position an der zweiten Oberfläche des Kopfsubstrats (1) angeordnet ist, wobei die Tintenkammer (4) mit einem anderen Ende einer jeden der Druckkammern (2) über einen Durchflußweg (14) in Verbindung steht, welcher sich durch das Kopfsubstrat (1) hindurch in Dickenrichtung erstreckt und einen eingeschnürten Abschnitt (3) aufweist,
wobei das eine Reihe von Tintenwegen aufweisende Kopfsubstrat (1) die Druckkammer (2) umfaßt und die Tintenkammer (4) durch Spritzgießen eines Harzes mit hohem Molekulargewicht ausgebildet ist; und
der eingeschnürte Bereich (3) des Durchflußweges (14) durch maschinelle Bearbeitung mittels Laserstrahl hergestellt ist.
2. Tintenstrahlaufzeichnungskopf gemäß Anspruch 1, bei dem die Tintenkammer (4) ringförmig ist und die Vielzahl von Druckkammern (2) umgibt.
3. Tintenstrahlaufzeichnungskopf gemäß Anspruch 1 oder 2, bei dem die Tintenkammer in einer Position an der zweiten Oberfläche des Kopfsubstrats (1) angeordnet ist und zumindest einen Teil der Druckkammer (2) überschneidet.
4. Tintenstrahlaufzeichnungskopf gemäß einem der vorhergehenden Ansprüche, bei dem die Tintenkammer (4) eine glatte Form ohne Ecken aufweist.
5. Tintenstrahlaufzeichnungskopf gemäß einem der Ansprüche 1 bis 4, bei dem Platten (8), die aus dem gleichen Material wie das Kopfsub-



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strat bestehen, über der Reihe von Druckkammern (2) verbunden sind.

laquelle des plaques (8) réalisées en le même matériau que celui dudit substrat de tête sont liées sur ledit groupe de chambres de pression (2).

Revendications

1. Tête d'enregistrement à jet d'encre comprenant :
 - un substrat de tête de configuration générale plane (1) ;
 - une pluralité de chambres de pression (2) formées par évidement dans une première surface dudit substrat ; et
 - une pluralité, en un nombre égal, de buses d'éjection d'encre (7) dont chacune débouche au niveau d'une seconde surface opposée dudit substrat (1) par l'intermédiaire d'une voie d'écoulement (5) qui traverse ledit substrat et qui communique de façon ouverte avec une extrémité (2a) d'une chambre de pression associée (2); et caractérisée en ce qu'elle comprend en outre :
 - une chambre d'encre (4) agencée en une position qui se trouve sur la seconde surface dudit substrat de tête (1), ladite chambre d'encre (4) communiquant avec une autre extrémité de chacune desdites chambres de pression (2) par l'intermédiaire d'une voie d'écoulement (14) qui traverse ledit substrat de tête (1) dans le sens de l'épaisseur, ladite voie d'écoulement (14) comportant une partie étranglée (3) ;
 - ledit substrat de tête (1) muni d'une série de voies d'encre incluant lesdites chambres de pression (2), ladite chambre d'encre (4) étant formée au moyen d'un moulage par injection d'une résine de poids moléculaire élevé ; et
 - ladite partie étranglée (3) de ladite voie d'écoulement (14) étant usinée en utilisant un faisceau laser.
2. Tête d'enregistrement à jet d'encre selon la revendication 1, dans laquelle ladite chambre d'encre (4) est annulaire et entoure ladite pluralité de chambres de pression (2).
3. Tête d'enregistrement à jet d'encre selon la revendication 1 ou 2, dans laquelle ladite chambre d'encre est agencée en une position qui se trouve sur une seconde surface dudit substrat de tête (1) et qui chevauche au moins une partie de ladite chambre de pression (2).
4. Tête d'enregistrement à jet d'encre selon l'une quelconque des revendications précédentes, dans laquelle ladite chambre d'encre (4) présente une forme douce sans angles.
5. Tête d'enregistrement à jet d'encre selon l'une quelconque des revendications 1 à 4, dans