

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 709 194 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
10.02.1999 Bulletin 1999/06

(51) Int. Cl.⁶: **B41J 2/025**

(21) Application number: **95307233.7**

(22) Date of filing: **12.10.1995**

(54) Ink jet printhead

Tintenstrahldruckkopf

Tête d'imprimante à jet d'encre

(84) Designated Contracting States:
DE FR GB

(30) Priority: **24.10.1994 GB 9421389**

(43) Date of publication of application:
01.05.1996 Bulletin 1996/18

(73) Proprietor:
DOMINO PRINTING SCIENCES PLC
Cambridge CB3 8TU (GB)

(72) Inventors:
• **Zaba, Jerzy Marcin**
Histon, Cambridge CB4 4HY (GB)
• **Tomlin, Matthew Brian**
Cambridge CB1 3BU (GB)

• **Chamberlain, Colin Edward**
Hitchin, Herts SG6 0QY (GB)

(74) Representative:
Brunner, Michael John
GILL JENNINGS & EVERY
Broadgate House
7 Eldon Street
London EC2M 7LH (GB)

(56) References cited:
EP-A- 0 084 891 **EP-A- 0 275 211**
US-A- 4 065 774 **US-A- 4 095 232**
US-A- 4 138 687 **US-A- 4 387 383**
US-A- 4 641 153

Note: Within nine months from the publication of the mention of the grant of the European patent, any person may give notice to the European Patent Office of opposition to the European patent granted. Notice of opposition shall be filed in a written reasoned statement. It shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 0 709 194 B1

Description

[0001] The present invention relates to ink jet print-heads and, more particularly, to ink jet printheads for use in continuous ink jet printers having multiple streams of ink issuing through corresponding orifices.

[0002] In order to create streams of droplets from the ink issuing through multiple nozzles or orifices it is known to use a method known as "velocity modulation" to vibrate the chamber from which the jets emerge, and it is also known to pressure modulate the fluid itself by means of plural piezoelectrically actuated drive rods or a single piezoelectrically actuated armature. Attempts have been made to utilise a unimorph structure in order to create pressure waves within the chamber, but investigations have shown that, at the required frequency of around 64kHz, the use of the single unimorph causes uneven break-up length along the array of jets which in turn results in poor definition at best.

[0003] Analysis of the modal vibration of the unimorph indicated that the unimorph was vibrating in complex modes which appeared to have displacement anti-nodes all along the length of the unimorph. The present invention has, as an object, the desire to overcome such non-uniformity in the array of jets. EP-A-0084891 discloses a multi-jet single head continuous ink jet printer with multiple actuators mounted on a base and operated in phase.

[0004] According to the present invention, there is provided an ink jet printhead for a continuous ink jet printer, comprising a housing having a chamber to which ink is supplied in use, the chamber having a row of orifices through which streams of ink are continuously ejected in use and broken up into droplets under the action of an actuator bounding a portion of the chamber, characterised in that

the actuator comprises a body having a plurality of sockets, a membrane or membranes disposed so as to close one side of each of the sockets, and a piezoelectric or electrostrictive transducer disposed within each socket and mounted on the membrane closing the one side of the socket.

[0005] Preferably, a single membrane closes all the sockets and is bonded to a face of the actuator body. The membrane is stainless steel in a preferred embodiment. Each transducer is preferably adhesively bonded to the membrane at the centre of the side of the respective socket. The necessary electrical connections can be provided by wire bonding conductors to the transducers. These measures ensure repeatability and uniformity, enabling plural printheads to be arranged in end-to-end relationship to form an elongate assembly of orifices.

[0006] One example of a printhead constructed in accordance with the present invention will now be described with reference to the accompanying drawings

in which:

Figure 1 illustrates, diagrammatically, an ink jet printhead droplet generator with the parts exploded;

Figure 2 is a longitudinal sectional view of the actuator for the printhead; and,

Figure 3 is a plan view of the actuator.

[0007] Figure 1 shows the actuator in an exploded isometric view, the actuator comprising a stainless steel body 1 which provides a chamber 2 for containing ink to be printed through multiple droplet streams 3 emitted through plural orifices in a stainless steel nozzle plate 4 which is attached to one face of the body 1.

[0008] On the other side of the body 1 to the nozzle plate 4 there is disposed a rectangular stainless steel foil or membrane 5 which is clamped to the face of the body 1 by a rigid clamping plate 6. In Figure 1 the clamping is shown as being provided by bolts 7. Prior to being clamped onto the body 1 the foil or membrane 5 is bonded to the (as shown) underside of the clamping plate 6. The clamping plate 6 has, as shown, four circular bores 8 which extend through it and the foil or membrane 5 has on it a correspondingly arranged row of disk-like unimorph piezoelectric crystals 9. The diameter of the unimorph crystals 9 is less than the bores 8 so that there are provided, in effect, a plurality of clamped foil disks along the length of the chamber 2.

[0009] In this arrangement the crystals 9 can be energised simultaneously to flex their respective disks at the same time thus creating a uniform disturbance in the ink within the chamber.

[0010] Such a multiple-unimorph structure has the advantage that a circular foil disk has a much higher fundamental mode of vibration than the rectangular foil of the prior design. For example, a 30mm by 6mm rectangle of 180 micron thick steel has a fundamental vibration frequency of 27.4kHz whereas a 6mm diameter disk of the same material has a fundamental vibration frequency of 49.3kHz. It is advantageous that the nearest higher mode of vibration is 1.6 times the fundamental frequency because the disk will be likely to vibrate purely in the fundamental mode when excited at 50kHz.

[0011] A further advantage of the construction is that it may be made modular so that a long array of nozzles may be accommodated simply by increasing the length of the chamber and the foil/membrane and the number of piezoelectric crystals or transducers. Crosstalk is also minimised by the bonding of the foil to the clamping plate 6.

Claims

1. An ink jet printhead for a continuous ink jet printer, comprising

a housing (1) having a chamber (2) to which ink is supplied in use, the chamber (2) having a row of orifices through which streams of ink are continuously ejected in use and broken up into droplets under the action of an actuator (5,6,9) bounding a portion of the chamber, characterised in that

the actuator comprises a body (6) having a plurality of sockets (8), a membrane or membranes (5) disposed so as to close one side of each of the sockets, and a piezoelectric or electrostrictive transducer (9) disposed within each socket and mounted on the membrane closing the one side of the socket.

2. A printhead according to claim 1, wherein a single membrane (5) closes all the sockets (8) and is bonded to a face of the actuator body (6).

3. A printhead according to claim 1 or claim 2, wherein the membrane (5) is stainless steel.

4. A printhead according to any of claims 1 to 3, wherein each transducer (9) is adhesively bonded to the membrane (5) at the centre of the side of the respective socket (8).

5. A printhead according to any of claims 1 to 3, wherein electrical connections are provided by conductor wires bonded to the transducers (9).

6. A continuous ink jet printer having a printhead according to any of claims 1 to 5.

Patentansprüche

1. Tintenstrahldruckkopf für kontinuierlich arbeitende Tintenstrahldrucker, mit

einem Gehäuse (1), das eine Kammer (2) hat, der im Gebrauch Tinte zugeführt wird, wobei die Kammer (2) eine Reihe Öffnungen hat, durch die Tintenströme im Gebrauch kontinuierlich ausgestoßen und unter der Einwirkung einer Betätigungsvorrichtung (5, 6, 9) zu Tropfen zerstäubt wird, die an einen Abschnitt der Kammer angrenzt, **dadurch gekennzeichnet**, daß die Betätigungsvorrichtung einen Körper (6) mit einer Mehrzahl Fassungen (8), eine Membran oder Membranen (5), die so angeordnet ist (sind), daß eine Seite jeder der Fassungen verschlossen ist, und einen piezoelektrischen oder elektrostriktiven Wandler (9) aufweist, der in jeder Fassung angeordnet und auf der Membran angebracht ist, welche die eine Seite der Fassung verschließt.

2. Druckkopf nach Anspruch 1, bei dem eine einzelne

Membran (5) sämtliche Fassungen (8) verschließt und an einer Seite des Körpers (6) der Betätigungsvorrichtung befestigt ist.

3. Druckkopf nach Anspruch 1 oder Anspruch 2, bei dem die Membran (5) nichtrostender Stahl ist.

4. Druckkopf nach irgendeinem der Ansprüche 1 bis 3, bei dem jeder Wandler (9) klebend an der Membran (5) in der Mitte der Seite der jeweiligen Fassung (8) befestigt ist.

5. Druckkopf nach irgendeinem der Ansprüche 1 bis 3, bei dem elektrische Verbindungen durch Leiterdrähte bereitgestellt werden, die an den Wandlern (9) befestigt sind.

6. Kontinuierlich arbeitender Tintenstrahldrucker mit einem Druckkopf gemäß irgendeinem der Ansprüche 1 bis 5.

Revendications

1. Tête d'impression de type continu à jets d'encre pour imprimante à jets d'encre, comprenant

un boîtier (1) qui possède une chambre (2) à laquelle est transmise de l'encre pendant l'utilisation, la chambre (2) ayant une rangée d'orifices par lesquels des courants d'encre sont projetés de façon continue en cours d'utilisation et sont divisés en gouttelettes sous l'action d'un organe de manoeuvre (5, 6, 9) qui délimite une partie de la chambre, caractérisé en ce que

l'organe de manoeuvre comporte un corps (6) ayant plusieurs logements (8), une ou plusieurs membranes (5) disposées afin qu'elles ferment un côté de chacun des logements, et un transducteur piézoélectrique ou à électrostriction (9) placé à l'intérieur du logement et monté sur la membrane qui ferme un côté du logement.

2. Tête d'impression selon la revendication 1, dans laquelle une membrane unique (5) ferme tous les logements (8) et est liée à une face du corps de l'organe de manoeuvre (6).

3. Tête d'impression selon la revendication 1 ou 2, dans laquelle la membrane (5) est formée d'acier inoxydable.

4. Tête d'impression selon l'une quelconque des revendications 1 à 3, dans laquelle chaque transducteur (9) est lié par collage à la membrane (5) au centre du côté du logement respectif (8).

5. Tête d'impression selon l'une quelconque des

revendications 1 à 3, dans laquelle les connexions électriques sont formées par des fils conducteurs liés aux transducteurs (9).

6. Imprimante de type continu à jets d'encre possédant une tête d'impression selon l'une quelconque des revendications 1 à 5.

10

15

20

25

30

35

40

45

50

55

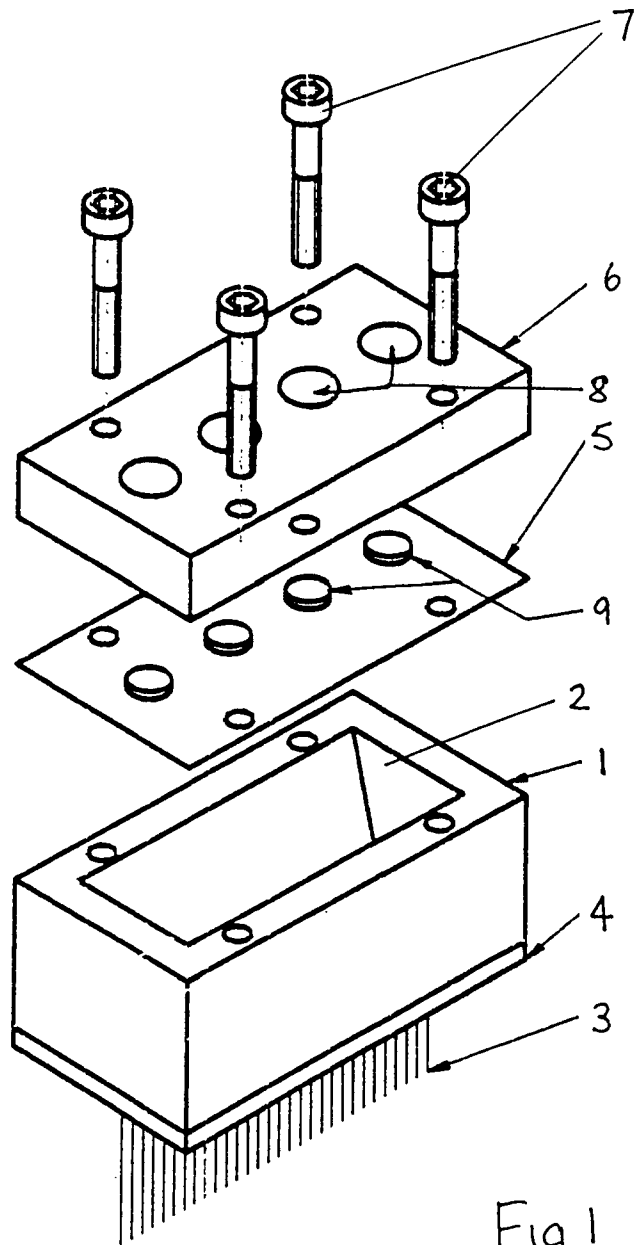


Fig 1

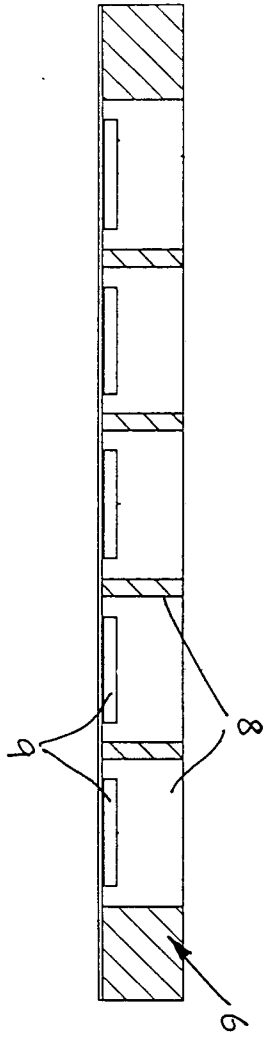


Fig 2

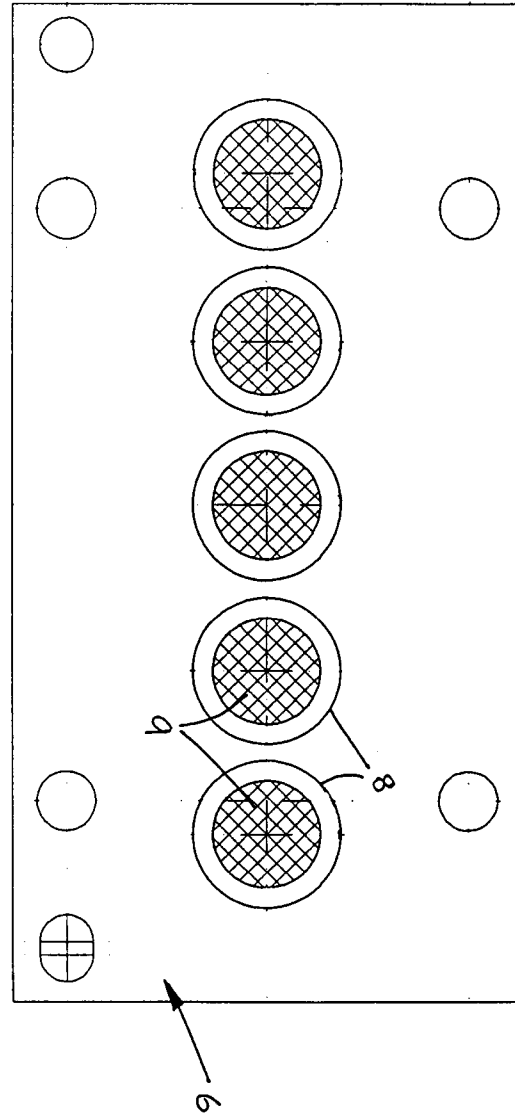


Fig 3