

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 0 709 194 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

01.05.1996 Bulletin 1996/18

(51) Int Cl.⁶: **B41J 2/025**

(21) Application number: **95307233.7**

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

(84) Designated Contracting States:
DE FR GB

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

(71) Applicant: **DOMINO PRINTING SCIENCES PLC**
Cambridge CB3 8TU (GB)

(72) Inventors:

- **Zaba, Jerzy Marcin**
Histon, Cambs 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)

(54) Ink jet printhead

(57) An ink jet printhead comprises a housing (1) having a chamber (2) to which ink is supplied in use and a row of orifices through which droplets are ejected in use under the action of an actuator (5,6,9) bounding a portion of the chamber. The actuator (5,6,9) comprises a (6) body having a plurality of sockets (8), a membrane (5) or membranes disposed so as to close one side of each of the sockets (8), and a piezoelectric or electrostrictive transducer (9) disposed within each socket (8) and mounted on the membrane (5) closing the one side of the socket (8).

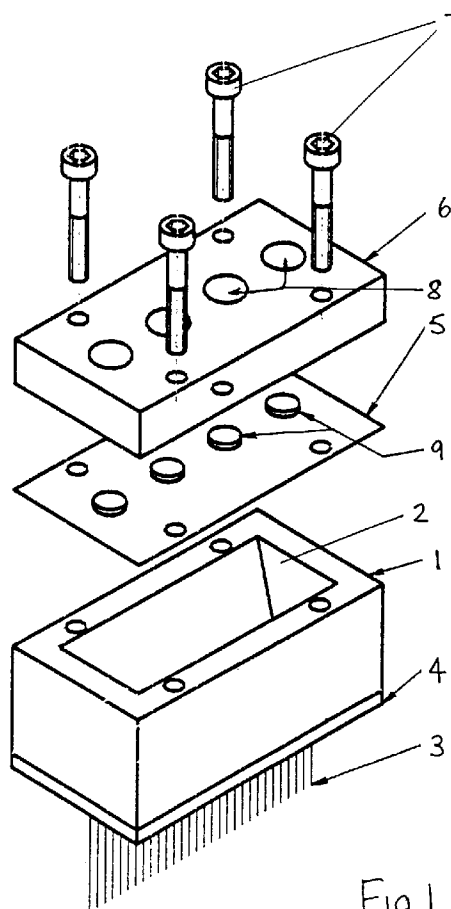


Fig 1

EP 0 709 194 A1

Description

The present invention relates to ink jet printheads and, more particularly, to ink jet printheads for use in continuous ink jet printers having multiple streams of droplets issuing through corresponding orifices.

In order to create streams of droplets 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.

Analysis of the modal vibration of the unimorph indicated that the unimorph was vibrating in complex modes which appeared to have displacement antinodes 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 printer with multiple actuators mounted on a base and operated in phase.

According to the present invention, an ink jet printhead comprises a housing having a chamber to which ink is supplied and having a row of orifices through which droplets are ejected in use under the action of an actuator bounding a portion of the chamber, the actuator comprising 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.

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.

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.

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.

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.

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.

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.

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 comprising

a housing (1) having a chamber (2) to which ink is supplied in use and a row of orifices through which droplets are ejected in use under the action of an actuator (5,6,9) bounding a portion of the chamber,
the actuator comprising 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). 5
3. A printhead according to claim 1 or claim 2, wherein the membrane (5) is stainless steel. 10
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). 15
5. A printhead according to any of claims 1 to 3, wherein electrical connections are provided by conductor wires bonded to the transducers (9). 20

20

25

30

35

40

45

50

55

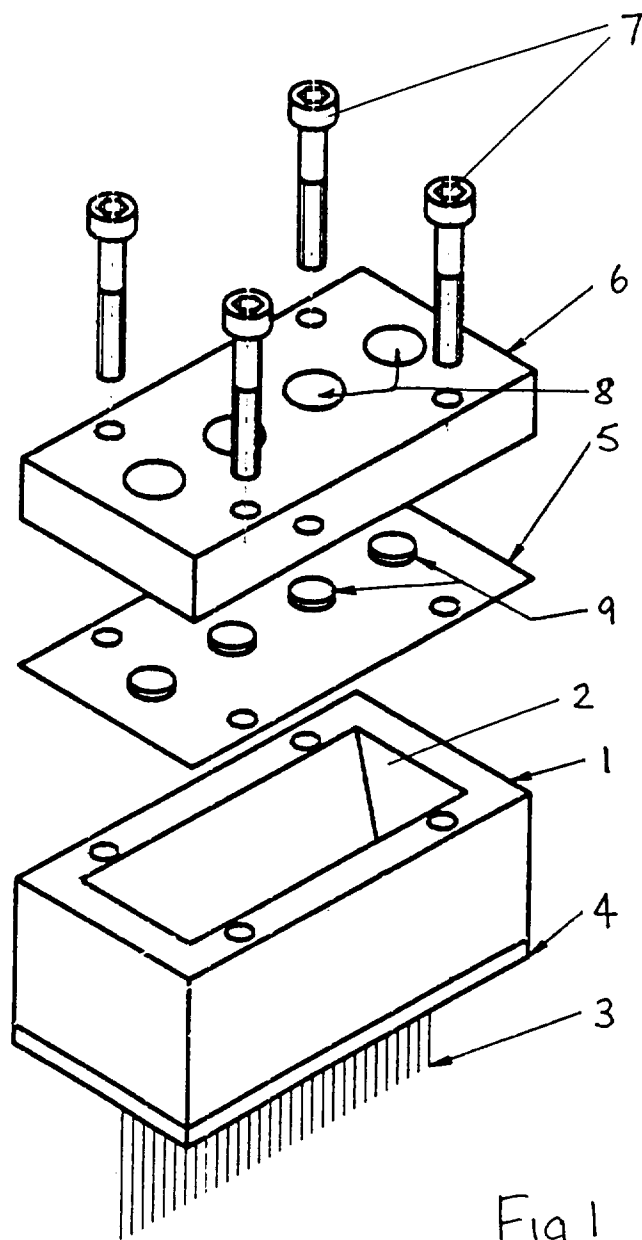


Fig 1

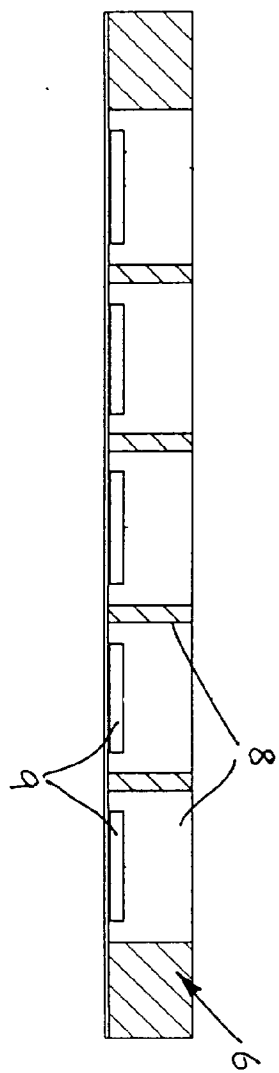


Fig 2

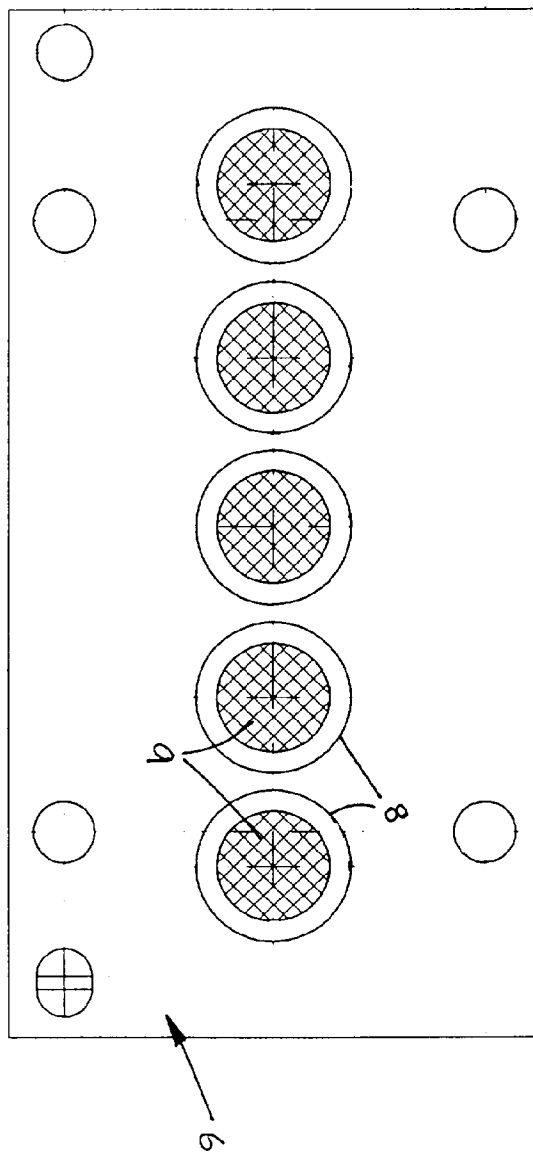


Fig 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 30 7233

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	US-A-4 138 687 (CHA ET AL.) * the whole document * ---	1-5	B41J2/025
A	US-A-4 095 232 (CHA) * the whole document * ---	1-5	
A	US-A-4 641 153 (CRUZ-URIBE) * the whole document * ---	1-5	
A	US-A-4 065 774 (LEE) * the whole document * ---	1-5	
A	US-A-4 387 383 (SAYKO) * the whole document * -----	1-5	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B41J
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 December 1995	Examiner Joosting, T
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)