

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) Publication number:

0 261 764 B1

(12)

EUROPEAN PATENT SPECIFICATION(45) Date of publication of patent specification: **30.10.91** (51) Int. Cl.5: **B41J 2/175**(21) Application number: **87305776.4**(22) Date of filing: **30.06.87**

(54) Ink reservoir containing an absorbent foam for an ink jet printing device.

(30) Priority: **01.07.86 US 880774**(40) Date of publication of application:
30.03.88 Bulletin 88/13(45) Publication of the grant of the patent:
30.10.91 Bulletin 91/44(64) Designated Contracting States:
DE FR GB IT(56) References cited:
EP-A- 0 021 389
US-A- 3 967 286

Hansjürgen Saechtling "Kunststoff Taschen-
buch", 22.Ausgabe, 1983, Carl Hanser Verlag
München-Wien, Seite 429

Kirk Othmer "Encyclopedia of chemical
technology" 3rd edition, vol.23 John Wiley &
Sons, 1982, p. 605

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EP 0 261 764 B1

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Description

Technical Field

This invention relates generally to thermal ink jet pen construction and more particularly to a single or multi-compartment pen body having improved ink storage and distribution capabilities.

Background Art

In the art of thermal ink jet printing, it is known to provide a bladder type of ink reservoir for supplying ink to a thermal ink jet printhead. The printhead will typically include a thin film resistor (TFR) substrate having a plurality of heater resistors therein, and a barrier layer and orifice plate member is usually mounted on top of the thin film resistor substrate. This member will typically include the ink reservoirs which are disposed above the heater resistors and further defines the corresponding drop generator nozzles for ejecting ink onto a print medium.

The bladder reservoir for supplying ink to the entire printhead may, for example, take the form of a rubber thimble which is located within the housing to which the thermal ink jet printhead is affixed. This type of reservoir and printhead construction is disclosed, for example, in the Hewlett Packard Journal, Volume 36, Number 5, May 1985, incorporated herein by reference.

Whereas these bladder type reservoirs have proven generally satisfactory for certain types of thermal ink jet (TIJ) printers, they nevertheless take up too much space and are unable to hold a sufficiently large volume of ink for other types of printer applications.

Disclosure of Invention

Accordingly, the general purpose of this invention is to provide new and improved pen body construction adapted for use in thermal ink jet printers. This new pen body construction represents a significant departure from the bladder-type ink storage approach and includes a novel printhead and ink storage structural arrangement. In this arrangement, the above problems associated with the ink storage and ink delivery mechanisms of the prior art have been either eliminated or substantially minimized.

According to the present invention, there is provided an ink jet pen including, in combination:

- a. a housing and a support member having a support surface at one end thereof with at least one opening for passing ink therethrough;
- b. an ink jet printhead mounted on said support surface and having a plurality of ink ejection

orifices, the or each said opening communicating with said orifices; and

- c. an absorbent foam material mounted within said housing and support member for receiving and retaining a supply of ink which is fed through said the or each opening and to said ink jet printhead;

characterised in that

the foam material in the region adjacent to said the or each opening is compressed, whereby capillarity in said region is increased as compared to the capillarity of the foam when uncompressed.

An ink jet pen having the features specified in the precharacterising clause of the preceding paragraph is disclosed in US-A-3 967 286.

Preferably the ink jet pen includes a controlled porosity polyurethane foam. This foam has been reticulated to break the walls of small membranes within the foam material and thereby increase the mobility of ink flow therein. The foam is also compressed to reduce the pore size therein to in turn reduce the foam thickness while increasing its density. In this manner, the desired capillarity of the foam can be controlled. By this process, the capillary force of the foam is increased and thereby renders this ink storage medium especially well suited for feeding ink to a thin film resistor type of thermal ink jet printhead. Furthermore, this ink feed apparatus is provided using a minimum of space (volume) to house the foam, and it features a corresponding maximum of ink storage capability in the foam. In addition, this polyurethane foam is economical to provide and is particularly adaptable for insertion into separate adjacent compartments of a pen body housing. This housing may then be used to store ink in various colors, such as cyan, magenta, and yellow, in a disposable pen body according to one embodiment of the invention.

The various advantages and novel features of this pen body construction will become more readily apparent in the following description of the accompanying drawing.

Brief Description of the Drawings

Figure 1 is an exploded view of the pen body construction according to one embodiment of the invention; and

Figure 2 is a cross section view taken along lines 2-2 of Figure 1.

Best Mode for Carrying Out the Invention

Referring now to Figure 1, there is shown a three compartment pen body designated generally as 10 and having three (3) ink storage compartments 12, 14 and 16 therein as indicated by the dashed line divider partitions within the interior of

the body 10. The pen body 10 further includes an output printhead support surface 18 which is joined to upstanding side walls 20 in a rectangular receptacle configuration. This structure further includes three (3) ink output ports 22, 24 and 26 respectively communicating with the three ink storage compartments 12, 14 and 16.

The rectangular support receptacle 18 is configured to receive a thin film resistor type printhead 28 having a plurality of ink ejection orifice groups 30, 32 and 34 respectively which are circular in geometry and which communicate with the ink flow passages 22, 24 and 26 extending to the surface 18 of the rectangular support receptacle.

In the assembly of Figure 1, three ink filters 36, 38 and 40 are mounted within the compartments 12, 14 and 16, respectively. These filters are typically constructed from stainless wire mesh of a desired porosity to provide good filtration of air bubbles and solid particles when passing ink from the three sections 42, 44 and 46 of polyurethane foam located in the three compartments 12, 14 and 16 of the pen body 10.

The back surface 48 of the foam body sections 42, 44 and 46 is fitted with a plug generally designated as 50, and this plug including its end cover 51 prevents back-pressure build up and facilitates the removal of ink from the foam and through the filters 36, 38 and 40 to the printhead 28. Air vents 52 are covered with porous plastic membranes 54 which prevent ink from leaking out through the air vents 52. The remaining structural detail of these three vents 52 and their intermediate wall partitions 66 and 68 is shown in a larger cross-section view in Figure 2 below. As previously indicated, the foam material of sections 42, 44 and 46 is a controlled porosity ether-type polyurethane foam which has been reticulated to break the membrane walls therein. This increases the capillary force of the foam and thereby renders it especially well suited for feeding ink along the ink feed paths to a thin film resistor thermal ink jet printhead. The plug 50 further includes foam compression tabs 56 which extend into the foam sections 42, 44 and 46 as shown and provide a desired amount of compressive forces to the foam for further increasing capillary forces in the foam and optimizing ink dispensation to the printhead.

The particular foam which has been used in actual practice is an ether-type foam material obtained from the Scott Paper Company of Philadelphia, Pennsylvania and had a porosity of between 60 and 75 pores per inch.

Referring now to Figure 2, the cross section view in this figure is taken along lines 2-2 of Figure 1 wherein like reference numerals have been used in both figures to identify the same components therein. The pen body 10 includes interior walls 62

and 64 which serve to partially define the three compartments for receiving the rectangular sections 42, 44 and 46 of foam as shown in Figure 1. These interior walls 62 and 64 receive the corresponding T-shaped interior extensions 66 and 68 of the cover or end member 51 of the previously described end plug 50. This plug 50 further includes air vents 70, 72 and 74 which communicate with the cavities or recessed portions 76, 78 and 80 as shown. These recessed portions or cavities 76, 78 and 80 in the cover member 51 of the plug 50 receive a plurality of porous membranes 82, 84 and 86 which are fabricated from polytetrafluoroethylene (PTFE) and which provide adequate ventilation within the three compartments of foam. At the same time, these membranes 82, 84 and 86 are of sufficient mesh density to prevent ink back-flow through the three air vents 70, 72 and 74.

A plurality of ink chambers 88, 90 and 92 are provided as shown in the three ink pipes 94, 96 and 98, respectively, in the pen body 10. Each of these ink pipes 94, 96 and 98 are provided, respectively, with the three previously identified wire mesh filters 40, 38 and 36. These latter filters provide filtering of air bubbles and solid particles from the ink which ultimately passes through the ink pipes 88, 90 and 92 and to the TFR printhead 28. This ink flow path also includes the lateral ink passage located between the surface 100 of the pen body 10 and the facing surface of the semiconductor substrate member 102 of the TFR printhead substrate 28.

The geometrical configuration of the ink pipes 94, 96 and 98 in combination with the walls 62, 64 and 66 and the spacing therebetween beneath the foam increases the compression of the foam in the areas above the three filters as shown in Figure 2. This fact in turn increases the capillarity of the foam in the region thereof above these three filters and thus reduces the possibility of air bubbles interrupting the ink path through the foam and into the three ink pipes 94, 96 and 98.

The substrate member 102 is bonded to a nozzle plate 104 by means of an adhesive barrier 106. This barrier 106 may advantageously be a selected polymer material such as the RISTON or VACREL trade name polymer materials made available by the E. I. DuPont Company of Wilmington, Delaware. The ink will flow through the ink pipes 88, 90 and 92 and then into the three passages 108, 110 and 112 in the substrate member 102. These vertical passageways 108, 110 and 112 will then feed ink to the plurality of groups of orifices 30, 32 and 34 in the nozzle plate 104 and located in a circular pattern as shown.

The nozzle plate 104 may advantageously be electroformed of nickel and plated with gold and then affixed to the polymer barrier material 106

using, for example, the heat staking process disclosed and claimed in copending application serial number 861,192 of Stephen J. Nigro et al. This application is entitled "Process For Manufacturing Thermal Ink Jet Printheads and Structures Produced Thereby", and is assigned to the present assignee and incorporated herein by reference. The nozzle plate 104 may be fabricated in the manner described in the above identified Hewlett Packard Journal, Vol. 38, No. 5 May 1985.

Finally, the thin film resistor structure 28 is secured to the bottom facing surface 100 of the pen body 10 by means of a suitable adhesive 114 which is disposed as shown at the outer periphery of the substrate 102, as well as at interior recessed wall surfaces 116 and 118 thereof.

The present invention is not limited to thermal ink jet applications and may instead be used in other types of ink jet applications in which the above foam storage-of-ink capability is desirable and compatible.

Industrial Applicability

The pen body according to this invention is useful in the manufacture of black and white and color printers and plotters operative in a variety of raster and vector modes.

Claims

1. An ink jet pen including, in combination:
 - a. a housing (10) and a support member having a support surface (18) at one end thereof with at least one opening (22,24,26) for passing ink therethrough;
 - b. an ink jet printhead (28) mounted on said support surface and having a plurality of ink ejection orifices (30,32,34), the or each said opening communicating with said orifices; and
 - c. an absorbent foam material (42,44,46) mounted within said housing and support member for receiving and retaining a supply of ink which is fed through said the or each opening and to said ink jet printhead;
 characterised in that
 - the foam material in the region adjacent to said the or each opening is compressed, whereby capillarity in said region is increased as compared to the capillarity of the foam when uncompressed.
2. An ink jet pen according to claim 1, in which said housing comprises at least one ink pipe (94,96,98) for feeding ink from said foam material to said printhead, each ink pipe being located between walls defining said housing,

spaced therefrom, and extending interiorly into said housing so as to compress the foam material in the region thereof adjacent each ink pipe.

3. An ink jet pen according to claim 1 or claim 2, in which said foam is reticulated polyurethane foam.
4. An ink jet pen according to any one of claims 1 to 3, in which the housing is divided into three ink storage compartments, each of said compartments containing a said compressed foam material (42,44,46) and communicating with a different plurality of ink ejection orifices (30,32,34) whereby each compartment may store and dispense a different ink.
5. An ink jet pen according to claim 4 wherein the three compartments store, respectively, cyan, magenta, and yellow ink.
6. An ink jet pen according to any one of claims 1 to 3 wherein said housing forms a single compartment which stores black ink.
7. An ink jet pen according to any one of claims 1 to 6 wherein the foam material has a porosity of between 60 and 75 pores per inch.
8. An ink jet pen according to any one of claims 1 to 7 wherein a separate plurality of ink ejection orifices communicate with the or each opening.
9. An ink jet pen according to claim 8 wherein the orifices in each plurality are symmetrically disposed in a circle about their respective opening.

Revendications

1. Dispositif d'écriture à jet d'encre comprenant, en combinaison :
 - a. un élément formant logement (10) et support comportant une surface de support (18) à une de ses extrémités, munie d'au moins une ouverture (22, 24, 26) destinée au passage de l'encre ;
 - b. une tête d'impression (28) à jet d'encre montée sur ladite surface de support et comportant une pluralité d'orifices d'éjection d'encre (30, 32, 34) ladite ouverture, ou chacune desdites ouvertures communiquant avec lesdits orifices ; et
 - c. un matériau de mousse absorbante (42, 44, 46) mis en place à l'intérieur dudit élé-

ment formant logement et support en vue de recevoir et de contenir une charge d'encre qui passe dans ladite ouverture ou dans chacune desdites ouvertures jusqu'à ladite tête d'impression à jet d'encre,

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caractérisé en ce que

le matériau de mousse, dans la zone voisine de ladite ouverture ou de chacune desdites ouvertures, est comprimé, la capillarité dans ladite zone étant augmentée par comparaison avec la capillarité de la mousse lorsqu'elle n'est pas comprimée.

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2. Dispositif d'écriture à jet d'encre selon la revendication 1, dans lequel chaque logement comporte au moins un tuyau à encre (94, 96, 98) destiné à alimenter en encre ladite tête d'impression à partir dudit matériau de mousse, chaque tuyau à encre étant situé entre des parois délimitant ledit logement, en étant disposé à l'écart de celle-ci, et s'étendant intérieurement dans ledit logement de façon à comprimer le matériau de mousse dans la zone de celui-ci située à proximité de chaque tuyau à encre.
3. Dispositif d'écriture à jet d'encre selon la revendication 1 ou 2, dans lequel ladite mousse est de la mousse de polyuréthane réticulée.
4. Dispositif d'écriture à jet d'encre selon l'une quelconque des revendications 1 à 3, dans lequel le logement est divisé en trois compartiments de stockage d'encre, chacun desdits compartiments contenant un matériau (42, 44, 46) de mousse comprimée, comme évoqué, et communiquant avec une pluralité différente d'orifices d'éjection d'encre (30, 32, 34), chaque compartiment pouvant stocker et délivrer une encre différente.
5. Dispositif d'écriture à jet d'encre selon la revendication 4, dans lequel les trois compartiments stockent respectivement de l'encre cyan, de l'encre magenta et de l'encre jaune.
6. Dispositif d'écriture à jet d'encre selon l'une quelconque des revendications 1 à 3, dans lequel ledit logement constitue un seul compartiment qui stocke de l'encre noire.
7. Dispositif d'écriture à jet d'encre selon l'une quelconque des revendications 1 à 6, dans lequel le matériau de mousse a une porosité comprise entre 60 et 75 pores par pouce.

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8. Dispositif d'écriture à jet d'encre selon l'une quelconque des revendications 1 à 7, dans lequel une pluralité séparée d'orifices d'éjection d'encre communique avec l'ouverture, ou avec chaque ouverture.
9. Dispositif d'écriture à jet d'encre selon la revendication 8, dans lequel les orifices de chacune des pluralités d'orifices sont disposés symétriquement en cercle autour de leur ouverture respective.

Patentansprüche

1. Tintenstrahlschreiber mit einer Kombination aus:
 - a. einem Gehäuse (10) und einem Träger mit einer Trägerfläche (18) an dessen einem Ende mit mindestens einer Öffnung (22, 24, 26) für den Durchlaß von Tinte,
 - b. einem auf dieser Trägerfläche befestigten Tintenstrahldruckkopf (28) mit mehreren Tintenausstoßdüsen (30, 32, 34), wobei die oder jede der Öffnungen mit diesen Düsen in Verbindung stehen, und
 - c. einem absorbierenden Schaumstoff (42, 44, 46), der in dieses Gehäuse eingebaut ist und als Trägerstoff zum Aufnehmen und Aufbewahren eines Vorrats von Tinte wirkt, welche durch die oder jede Öffnung und zu dem Tintenstrahldruckkopf gefördert wird, dadurch **gekennzeichnet**, daß der Schaumstoff benachbart zu der oder jeder Öffnung komprimiert ist, wodurch die Kapillarität in diesem Bereich gegenüber der Kapillarität von nicht verdichtetem Schaumstoff erhöht ist.
2. Tintenstrahlschreiber nach Anspruch 1, bei dem das Gehäuse mindestens ein Tintenrohr (94, 96, 98) zum Speisen des Druckkopfes mit Tinte aus dem Schaumstoff aufweist, wobei jedes Tintenrohr zwischen das Gehäuse begrenzenden Wänden mit einem Abstand zu diesen liegt, und nach innen derart in das Gehäuse hineinragt, daß es in dem zu jedem Tintenrohr benachbarten Bereich den Schaumstoff komprimiert.
3. Tintenstrahlschreiber nach Anspruch 1 oder 2, bei dem der Schaum ein fasriger Polyurethanschaum ist.
4. Tintenstrahlschreiber nach einem der Ansprüche 1 bis 3, bei dem das Gehäuse in drei Tintenspeicherkammern geteilt ist, wobei jede dieser Kammern einen komprimierten Schaumstoff (42, 44, 46) enthält und mit verschieden

vielen Ausstoßdüsen (30, 32, 34) in Verbindung steht, wodurch jede Kammer eine andere Tinte speichern und abgeben kann.

5. Tintenstrahlschreiber nach Anspruch 4, bei dem die drei Kammern cyan-blaue, magenta-rote und gelbe Tinte speichern. 5
6. Tintenstrahlschreiber nach einem der Ansprüche 1 bis 3, bei dem das Gehäuse eine einzelne Kammer bildet, welche schwarze Tinte speichert. 10
7. Tintenstrahlschreiber nach einem der Ansprüche 1 bis 6, bei dem der Schaumstoff eine Porosität von zwischen 60 und 75 Poren/inch (23 - 30 Poren/cm) aufweist. 15
8. Tintenstrahlschreiber nach einem der Ansprüche 1 bis 7, bei dem verschieden viele Tinten-ausstoßdüsen mit der oder jeder Öffnung in Verbindung stehen. 20
9. Tintenstrahlschreiber nach Anspruch 8, bei dem jede der mehreren Düsen symmetrisch in einem Kreis um ihre zugeordnete Öffnung herum angeordnet sind. 25

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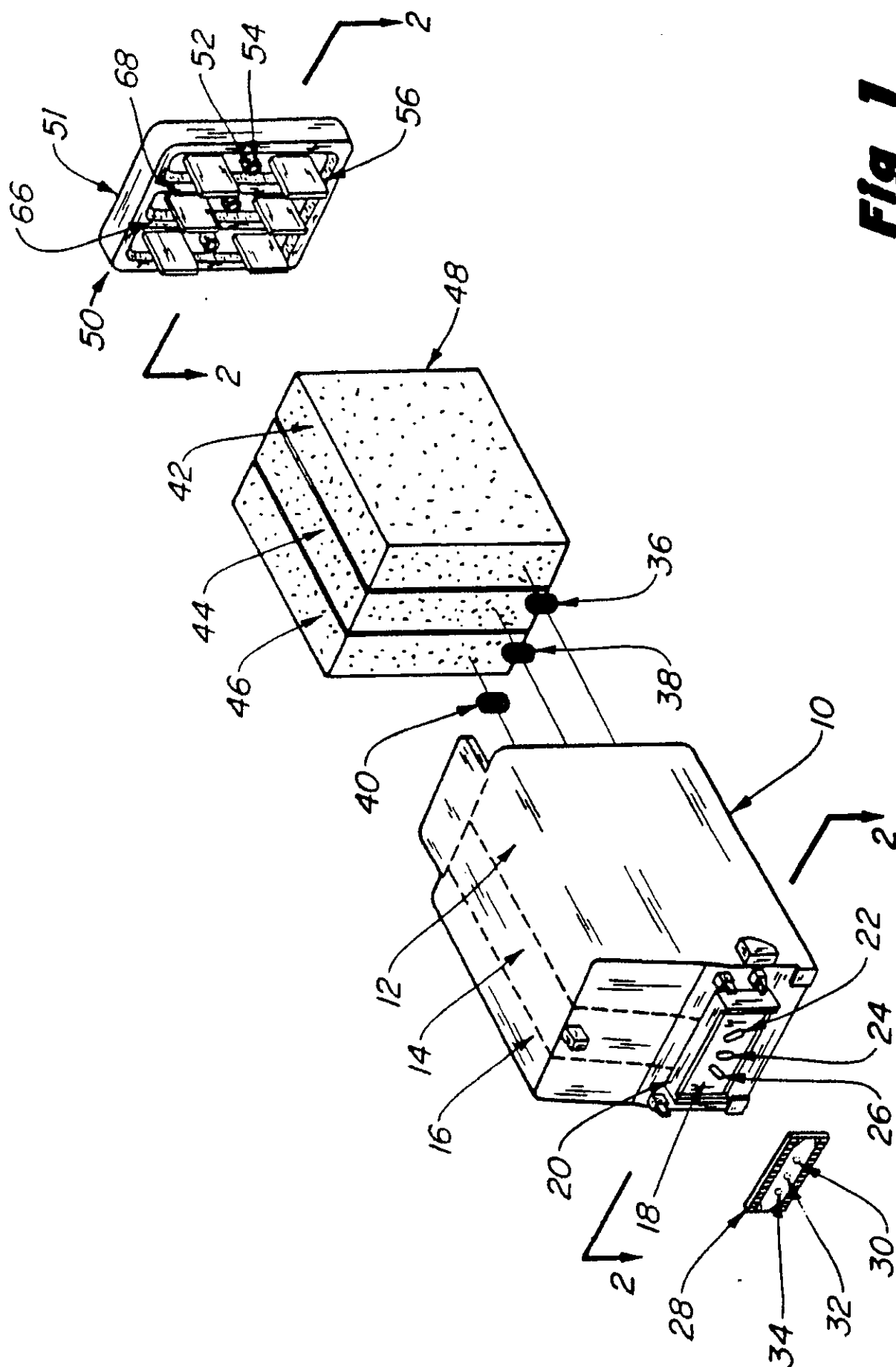


Fig 1

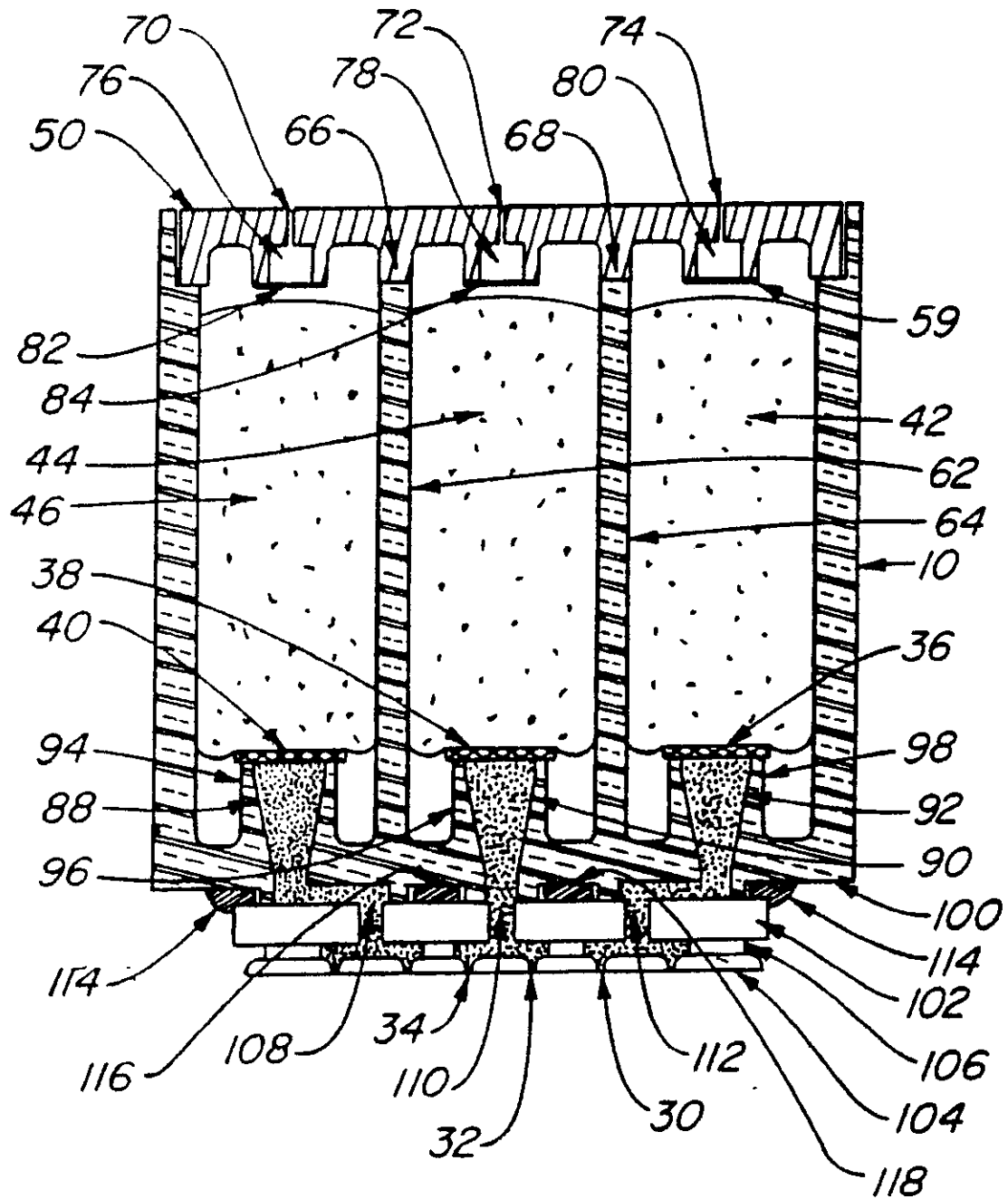


Fig 2

REGISTER ENTRY FOR EP0261764 ✓

European Application No EP87305776.4 filing date 30.06.1987 ✓

Priority claimed:

01.07.1986 in United States of America - doc: 880774

Divisional EP91200393.6

Designated States DE FR GB IT

Title INK RESERVOIR CONTAINING AN ABSORBENT FOAM FOR AN INK JET PRINTING
DEVICE

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Classified to

B6F

B41J G01D

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Publication No EP0261764 dated 30.03.1988

Publication in English

Examination requested 30.06.1987

Patent Granted with effect from 30.10.1991 (Section 25(1)) with title INK
RESERVOIR CONTAINING AN ABSORBENT FOAM FOR AN INK JET PRINTING DEVICE.

30.09.1991 Notification from EPO of change of Applicant/Proprietor details
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REGISTER ENTRY FOR EP0261764 (Cont.)

PAGE: 2

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Entry Type 25.14 Staff ID. RD06 Auth ID. EPT

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Entry Type 25.14 Staff ID. RD06 Auth ID. EPT

**** END OF REGISTER ENTRY ****

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EP

OPTICS - PATENTS

30/03/92 11:38:02
PAGE: 1

RENEWAL DETAILS

PUBLICATION NUMBER EP0261764 ✓

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DATE FILED 30.06.1987 ✓

DATE GRANTED 30.10.1991 ✓

DATE NEXT RENEWAL DUE 30.06.1992

DATE NOT IN FORCE

DATE OF LAST RENEWAL

YEAR OF LAST RENEWAL 00

STATUS PATENT IN FORCE ✓