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(54) Title: A DEVICE FOR THE INKJET PRINTING OF FLUIDS, IN PARTICULAR GLAZES, ONTO TILES

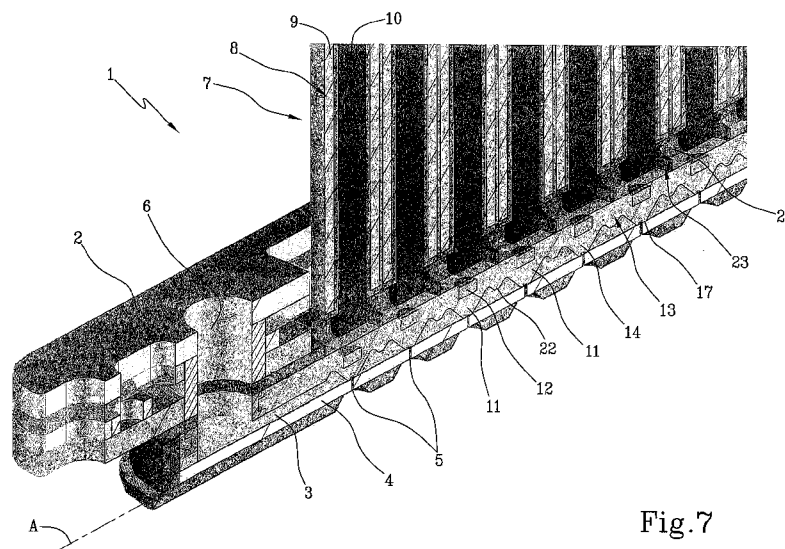


Fig.7

(57) Abstract: A device (1) for inkjet printing of fluids, particularly glazes, onto tiles (P) comprises a body (2) comprising a feed channel (3) of a printing fluid, which feed channel (3) is closed by a base (4). The base comprises at least one outlet nozzle (5) associated with a valve (7) comprising electromagnetic actuating means (8). A shutter (11) of the valve (7) comprises at least one sensitive element (12) made of a material suitable for interacting with the magnetic field generated by the electromagnetic actuating means (8) for moving the shutter. A membrane (13) is arranged within the body (2) and delimits the feed channel (3). The membrane (13) is interposed between the feed channel (3) and the electromagnetic actuating means (8). The shutter (11) is solidly constraint with the membrane (13).

A device for the inkjet printing of fluids, in particular glazes, onto tiles.

DESCRIPTION

The invention relates to a device for the inkjet printing of fluids, in particular glazes, onto tiles.

Such devices define a printhead via which a glaze is delivered through a series of outlet nozzles for decorating a tile arranged along a conveyor belt. To each outlet nozzle, a generally electromagnetic actuating valve is associated for opening the outlet nozzle according to the pattern which is to be reproduced on the tile. Closing of the outlet nozzle is generally ensured by elastic means. An example of an electromagnetic actuating valve is described in US2005/0056713, wherein an electromagnet provided with a ferromagnetic core, acts on a shutter of the outlet nozzle so as to shift the latter from the closed position to the open position thereof. The return movement, namely that from the open position to the closed position with maintained closing of the outlet nozzle, is ensured by a helical spring.

In known devices, the air-gaps provided for electromagnetic actuation are crossed by the glazes, which glazes are in contact with the elastic means, as well as the coil of the electromagnet and the ferromagnetic core.

Since the glazes contain impurities, such contact can lead to fouling or clogging, thereby resulting in limited operational capacities of the valve and hence in a consequent need for frequent maintenance.

Furthermore, the known devices are rather complex.

In this context, the technical task at the base of the present invention is to provide a device for inkjet printing of fluids, in particular glazes, onto tiles which overcomes the drawbacks of the known art mentioned above.

In particular, it is an object of the invention herein to provide a device for inkjet printing of fluids, in particular glazes, onto tiles, owing to which the

glaze flow exiting from the nozzle is caused to become reliable and constant.

A possible further object of the invention herein, is to provide a simple device by limiting the number of components required for operation thereof.

The technical task mentioned and the aims specified are substantially achieved by a device for inkjet printing of fluids, in particular glazes, onto tiles, comprising the technical features described in one or more of the appended claims. The technical task mentioned and the aims specified are substantially attained by a mould and method for producing a membrane of a device for inkjet printing of fluids, in particular glazes, onto tiles, comprising the technical features as described in one or more of the appended claims.

The dependent claims correspond to different embodiments of the invention.

According to a possible aspect, the invention relates to a device for inkjet printing of fluids, in particular glazes, onto tiles, including a body comprising a feed channel of a printing fluid, which feed channel is closed by a base comprising at least one outlet nozzle of the printing fluid. A valve comprises electromagnetic actuating means suitable for generating a magnetic field and a shutter, comprising at least one sensitive element made of a material suitable for interacting with the magnetic field for moving aforementioned shutter. The valve is operatively associated to the outlet nozzle so as to determine an open condition corresponding to an open position of the shutter, wherein the outlet nozzle is arranged in communication with the feed channel, and a closed condition corresponding to a closed position of the shutter in which the communication between the outlet nozzle and the feed channel is closed by said shutter. A membrane is disposed within the body and delimits the feed channel. The membrane is interposed between the feed channel and the electromagnetic actuating means. The shutter is solidly constraint to

the membrane.

In accordance with a second aspect, the present invention relates to a mould for realizing a membrane of a device for inkjet printing of fluids, in particular glazes, onto tiles. The mould comprises a cavity which is counter-shaped with respect to the membrane, as well as magnetic retaining means arranged outside said cavity and adapted to retain a sensitive element of the membrane in a given position inside aforesaid cavity.

According to a further aspect, the invention herein relates to a method for realizing a membrane of a device for inkjet printing of fluids, in particular glazes, onto tiles. The method comprises predisposing the mould, retaining the sensitive element in a determined position inside the cavity by means of the magnetic retaining means, injecting a material into the cavity so as to form at least one layer of the membrane thus surrounding the sensitive element at least partially.

In one or more of the above aspects, the present invention comprises one or more of the following features.

The shutter is preferably defined by a closing portion of the membrane which opens into the outlet nozzle.

The closing portion preferably is wedge-shaped with a lower base or vertex arranged towards the outlet nozzle.

Preferably, a closing portion is suitable for being inserted at least partially into the outlet nozzle in the closed position of the shutter.

Preferably, the sensitive element is disposed within the membrane.

Preferably, the membrane comprises at least two layers and the sensitive element is arranged between the two layers.

Preferably, the membrane comprises support walls projecting from opposite sides of the shutter, which sides laterally delimit the feed channel against the base.

Preferably the membrane is at least partially made of silicone material. The sensitive element being preferably a permanent magnet. The

electromagnetic actuating means are configured for generating a first attractive magnetic field and a second repulsive magnetic field of the sensitive element for moving the shutter between the closed position and the open position in both directions.

- 5 Preferably the sensitive element is made of ferromagnetic material so as to be attracted by the magnetic field generated by the electromagnetic actuating means.

The device preferably comprises a plurality of outlet nozzles arranged in line, each of which is associated with a corresponding valve. The
10 membrane comprises a stiffening portion disposed between two consecutive shutters.

Preferably it is provided predisposing a first layer of the membrane within the cavity of the mould, retaining the sensitive element resting against the first layer within the cavity by means of the retaining magnetic means,
15 injecting a material into the cavity so as to obtain at least a second layer of the membrane thus incorporating the sensitive element.

Further characteristics and advantages of the present invention will become more apparent from the indicative, and therefore non-limiting, description of a preferred but not exclusive embodiment of a device for
20 inkjet printing of fluids, in particular glazes, onto tiles, with reference to the appended drawings wherein:

- Figure 1 is a schematic view in section of a device for inkjet printing of fluids, in particular glazes, onto tiles;
- Figure 2 is a schematic view in section of a detail of the device of Figure
25 1;
- Figures 3 and 4 are schematic views in section of possible alternatives to the embodiment of Figure 2;
- Figure 5 shows the device of Figure 4 in a different operating condition;
- Figure 6 is a schematic view in section of a mould for realizing a
30 membrane of the device of figure 4 or 5;
- Figure 7 is a schematic perspective view in section of a device for inkjet

printing of fluids, in particular glazes, onto tiles;

- Figure 8 is a schematic view of a detail of the device of figure 7 in a perspective sectioned according to a plane perpendicular to the section plane of Figure 7.

- 5 With reference to the attached figures, the numeral 1 indicates a device for inkjet printing of fluids, in particular glazes, onto tiles P. Figure 1 illustrates the tile P transported on a conveyor belt N, so as to end into the device 1 thus receiving a determined quantity of fluid, in particular glaze S, according to the drawings or pre-established pictures.
- 10 The device 1 comprises a body 2 defining a printhead. Inside the body, a feed channel 3 of the printing fluid is realized, which feed channel 3 is closed by a base 4, comprising at least an outlet nozzle 5 of the printing fluid.

In the example illustrated in Figure 7 there is provided a plurality of outlet
15 nozzles 5 arranged in line along a line of extension A and fed by the same feed channel 3. There may be provided two or more nozzles aligned in a direction perpendicular to the line of extension thereby forming, by way of example, a nozzles array.

The body 2 also comprises an inlet channel 6 placed in communication
20 with the feed channel 3. The inlet channel 6 is adapted to be connected to a tank of pressurized fluid, which is not shown.

To each outlet nozzle 5, a valve 7 is operatively associated for determining an open condition thereof, wherein the outlet nozzle 5 is arranged in communication with the feed channel 3 and a closed condition, wherein
25 the communication between the outlet nozzle 5 and the feed channel 3 is prevented.

The valve 7 comprises electromagnetic actuating means 8 suitable for generating a magnetic field. The electromagnetic actuating means 8 particularly comprises an electromagnet comprising, by way of example, a
30 winding 9 and a ferromagnetic core 10.

The valve 7 also comprises a shutter 11 movable between an open

position corresponding to the condition wherein the outlet nozzle 5 opens, and a closed position corresponding to the condition in which the outlet nozzle 5 is closed.

The shutter 11 comprises at least one sensitive element 12 made of a material which is suitable for interacting with the magnetic field for moving said shutter 11. In the example illustrated in the figures, the sensitive element 12 is a permanent magnet of which the poles S and N were indicated. Preferably the electromagnetic actuating means 8 are configured for generating a first attractive magnetic field and a second repulsive magnetic field of the sensitive element 12 which is realized in the form of a permanent magnet, so as to move the shutter 11 between the closed position and the open position in both directions.

A membrane 13 is disposed within the body 2 and delimits the feed channel 3. Furthermore, the membrane 13 is interposed between the feed channel 3 and the electromagnetic actuating means 8.

Upon opening and/or closing of the outlet nozzle 5, the shutter 11 is solidly constraint with the membrane 13.

The shutter 11 is particularly defined by a closing portion 14 of the membrane 13 facing the outlet nozzle 5.

According to the embodiment illustrated in Figure 1 or 2, the closing portion 14 of the membrane 13 is a planar portion adapted to come into contact with the base 4. Preferably, the base 4 comprises a boundary ring 15 facing inwardly the feed channel 3 relative to each outlet nozzle 5, thereby defining a contact surface 16 suitable for coming into contact with the closing portion 14 of the membrane 13.

According to the embodiment illustrated in Figure 4 or 5, the closing portion 14 is wedge-shaped with the lower base 17 thereof arranged towards the outlet nozzle 5.

According to the embodiment illustrated in Figure 3, the closing portion 14 is wedge-shaped with the vertex 18 thereof disposed toward the outlet nozzle 5. In particular, the closing portion 14 is suitable for being inserted,

at least partially, into the outlet nozzle 5 when the shutter 11 is in its closed position.

Preferably the sensitive element 12 is arranged within the membrane 13. The membrane 13 particularly comprises at least two layers (a first layer 19 and a second layer 20) and the sensitive element 12 is disposed between the two layers.

According to a possible embodiment, illustrated by way of example in Figures 4 and 5, the membrane 13 comprises support walls 21 projecting from opposite sides of the shutter 11, which support walls 21 laterally delimit the feed channel 3 against the base 4. In particular, where there is provided a plurality of outlet nozzles 5, the support walls 21 are arranged parallel to the line of extension A, along which the outlet nozzles 5 are arranged.

In the case in which there is provided a plurality of outlet nozzles 5, the membrane 13 may comprise a stiffening portion 22 (Figure 7) arranged between two consecutive shutters 11. The thickness of the stiffening portion 22 is greater than the thickness of the membrane 13 and less than the thickness of the shutter 11. In other words, the stiffening portion 22 extends into the feed channel without coming into contact with the base 4.

According to a possible embodiment, the body 2 comprises a containment plate 23 arranged between the membrane 13 and the electromagnetic actuating means 8, said containment plate 23 comprising a through opening 24 for each outlet nozzle 5, which through opening 24 defines a portion of the membrane around the shutter 11. In particular, the through opening 24 extends up to the stiffening portion 22, if applicable.

Preferably, the membrane 13 is at least partially made of silicone material. With reference to the embodiment illustrated in the figures and comprising a permanent magnet in the form of a sensitive element, the device 1 according to the invention herein, provides in use, constant activation of the electromagnetic actuating means. In a first step, the electromagnetic actuating means are configured for generating a first attractive magnetic

field of the sensitive element, so that the shutter is moved from the closed position to the open position thereof (see for example Figure 5). In a second step, the electromagnetic actuating means are instead configured for causing a second repulsive magnetic field of the sensitive element, so that the shutter is moved from the open position to the closed position thereof and kept closing the outlet nozzle 5 (see for example Figures 2-4).

Referring to Figure 6, in order for the membrane 13 to be realized, it can be provided a mould 100 comprising a cavity 101 which is counter-shaped relative to the membrane shape. With reference to Figure 6, a first portion 102 of the mould is closed by a second portion 103, so as to define the cavity 101. An inlet 104 flows into the cavity 101 for access of the membrane forming material, e.g. pressure silicone. An outlet 105 flows outside the cavity 101 for the exit of air and silicone in excess.

By 106 there are indicated magnetic retaining means disposed outside the cavity 101 and suitable for retaining the sensitive element 12, particularly in the form of a permanent magnet in a determined position inside said cavity.

The membrane 13 can be realized by means of the mould 100 described hereinabove, i.e. by predisposing said mould 100 and by retaining the sensitive element 12 in a given position inside the cavity through the retaining means 106. The magnetic material suitable for realizing the membrane, is injected into the cavity 101 thereby forming at least a layer of said membrane, so that the sensitive element 12 is at least partially surrounded.

Preferably, in the case of two layers 19, 20, there is provided predisposing a first layer 19 of the membrane within the cavity 101, retaining the sensitive element 12 resting against the first layer 19 within the cavity 101 via the magnetic retaining means 106, injecting the material suitable for realizing the second layer 20 within the cavity 101, so as to incorporate the sensitive element 12.

Alternatively, a co-moulding can be provided wherein the second layer 20

is initially realized, and a housing for the sensitive element is therein defined by means of a mould insert. Subsequently the mould is opened for insertion of the sensitive element and then closed again, thus leaving a cavity corresponding to the first layer, if provided, into which the
5 corresponding material is injected.

CLAIMS

1. A device (1) for the inkjet printing of fluids, in particular glazes, onto tiles (P) comprising:
- a body (2) comprising a feed channel (3) of a printing fluid, which feed
- 5 channel (3) is closed by a base (4) comprising at least one outlet nozzle (5) of said printing fluid (S),
- a valve (7) comprising electromagnetic actuating means (8) adapted to generate a magnetic field and a shutter (11) comprising at least one
- 10 sensitive element (12) made of a material suitable for interacting with said magnetic field for the movement of the shutter itself, said valve (7) being operatively associated with said outlet nozzle (5) to determine an open condition corresponding to an open position of said shutter (11) wherein said outlet nozzle (5) is arranged in communication with said feed channel (3) and a closed condition corresponding to a closed position of said
- 15 shutter (11), wherein said shutter (11) closes communication between said outlet nozzle (5) and said feed channel (3),
- a membrane (13) arranged in said body (2) and delimiting said feed channel (3), wherein said membrane (13) is interposed between said feed channel (3) and said electromagnetic actuating means (8) and wherein
- 20 said shutter (11) is solidly constraint with said membrane (13).
2. The device according to claim 1, wherein a closing portion (14) of said membrane (13) facing said outlet nozzle (5) defines said shutter (11).
3. The device according to claim 2, wherein said closing portion (14) is wedge-shaped with a lower base (17) or vertex (18) arranged towards said
- 25 outlet nozzle (5).
4. The device according to claim 3, wherein said closing portion (14) is suitable to be inserted at least partially into said outlet nozzle (5) in the closed position of the shutter (11).
5. The device according to one or more of claims 2-4, wherein said
- 30 sensitive element (12) is arranged within said membrane (13).
6. The device according to claim 5, wherein said membrane (13)

comprises at least two layers (19, 20) and wherein said sensitive element (12) is arranged between said two layers (19, 20).

7. The device according to one or more of the preceding claims, wherein said membrane (13) comprises support walls (21) projecting from opposite
5 sides of said shutter (11) laterally delimiting said feed channel (3) against said base (4).

8. The device according to one or more of the preceding claims, wherein said membrane (13) is at least partially made of silicone material.

9. The device according to one or more of the preceding claims, wherein
10 said sensitive element (12) is a permanent magnet and wherein said electromagnetic actuating means (8) are configured to generate a first attractive magnetic field and a second repulsive magnetic field of said sensitive element (12) so as to move said shutter (11) between the closed position and the open position in both directions.

15 10. The device according to one or more of the preceding claims, wherein said sensitive element (12) is made of ferromagnetic material to be attracted by the magnetic field generated by said electromagnetic actuating means (8).

11. The device according to one or more of the preceding claims,
20 comprising a plurality of outlet nozzles (5) arranged in line, each associated with a relative valve (7), wherein said membrane (13) comprises a stiffening portion (22) arranged between two consecutive shutters (11).

12. The mould (100) for the creation of a membrane (13) of a device (1)
25 for the inkjet printing of fluids, in particular glazes, onto tiles (P) comprising a cavity (101) counter-shaped with respect to said membrane (13) and magnetic retaining means (106) arranged outside said cavity (101) and adapted to retain a sensitive element (12) of said membrane (13) in a determined position within the cavity itself.

30 13. The method for making a membrane (13) of a device (1) for the inkjet printing of fluids, in particular glazes, onto tiles (P) comprising providing a

mould (101) according to claim 12, retaining said sensitive element (12) in a determined position within the cavity (101) through said magnetic retaining means (106) and injecting a material into said cavity (101) to create at least one layer (19, 20) of said membrane (13) so as to surround
5 at least partially said sensitive element (12).

14. The method according to claim 13, comprising providing a first layer (19) of said membrane (13) within said cavity (101), retaining said sensitive element (12) resting against said first layer (19) within the cavity (101) through said magnetic retaining means (106), injecting a material
10 into said cavity (101) to create at least one second layer (20) of said membrane (13) so as to incorporate said sensitive element (12).

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Fig.1

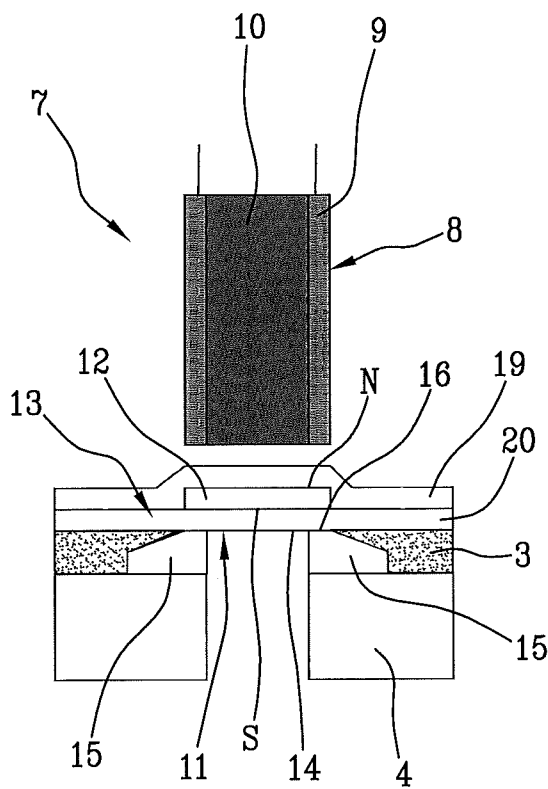
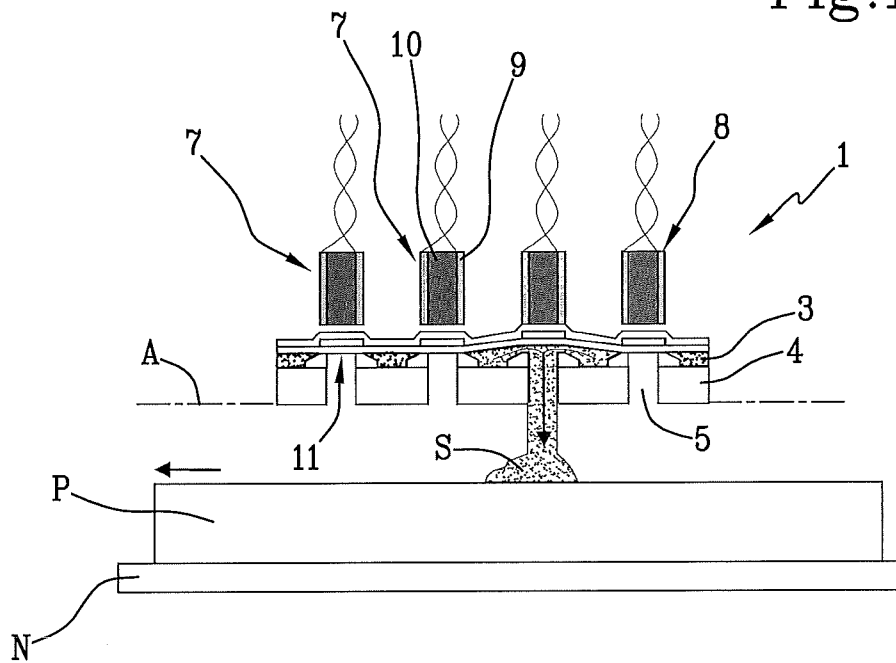


Fig.2

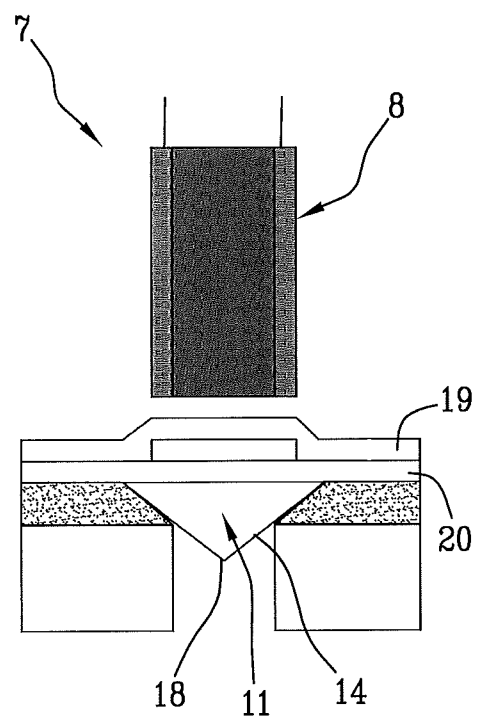


Fig.3

2 / 4

Fig.4

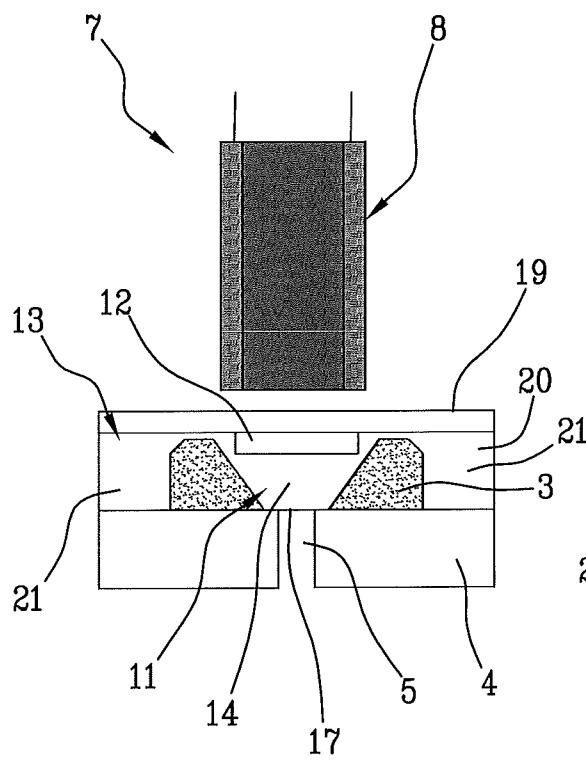


Fig.5

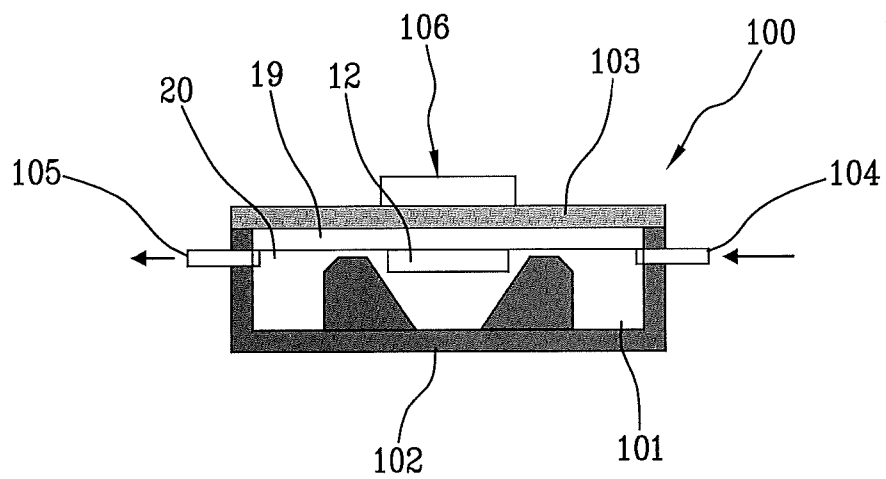
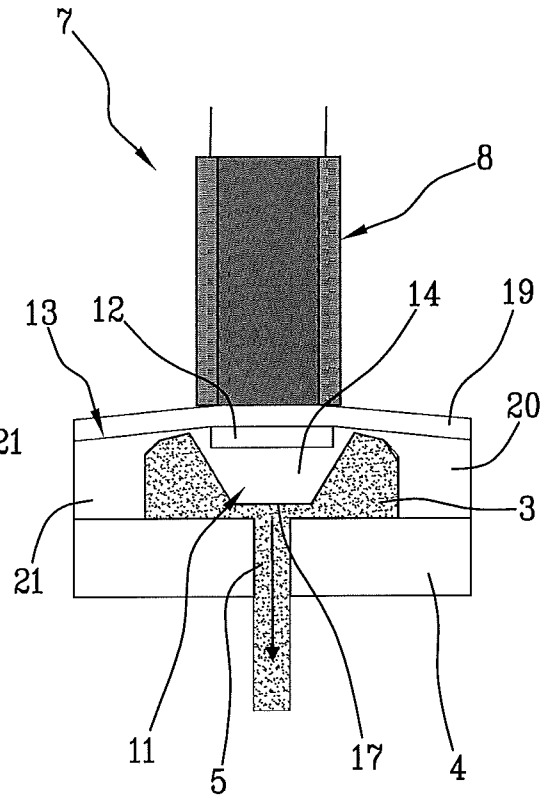


Fig.6

3 / 4

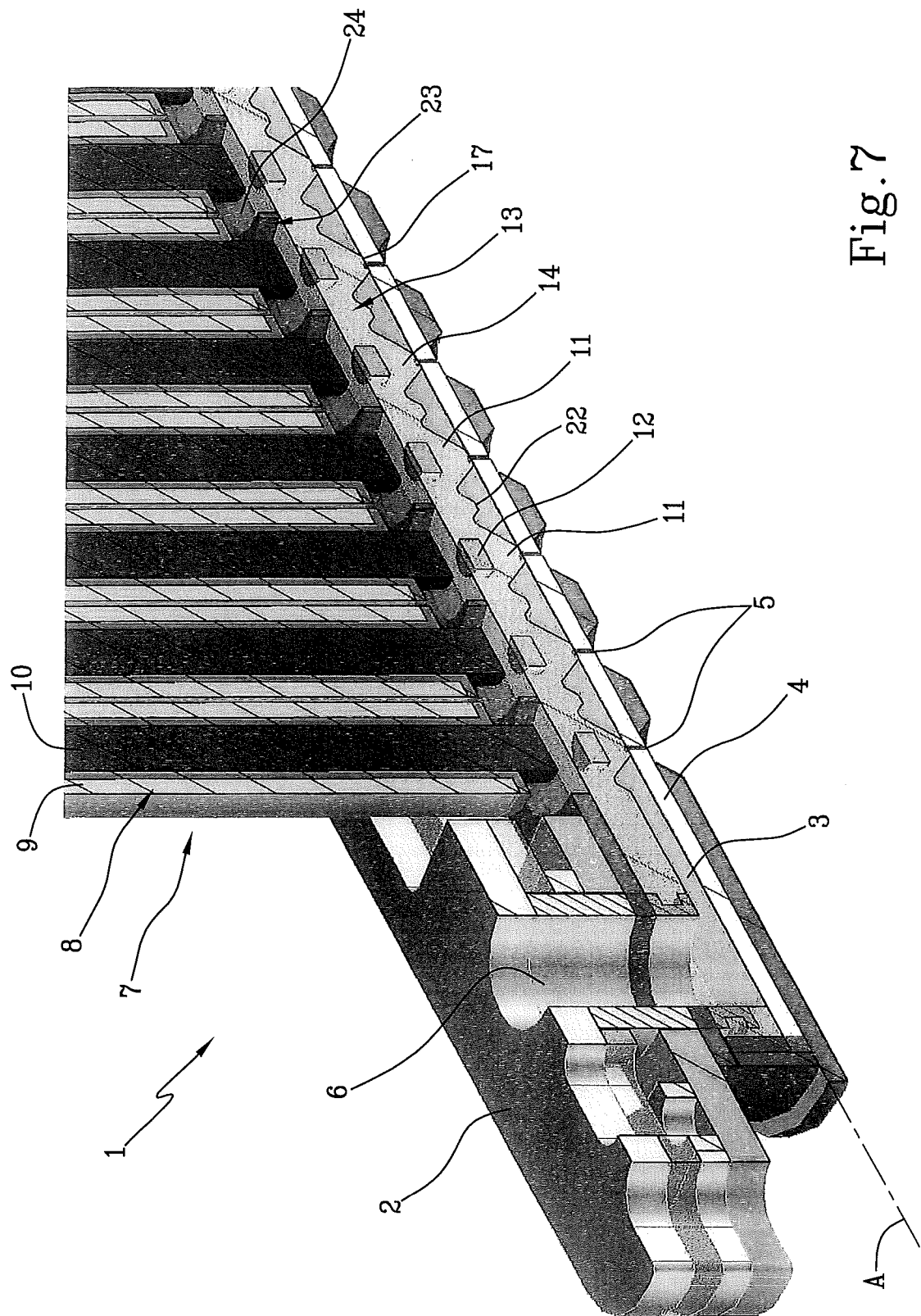


Fig. 7

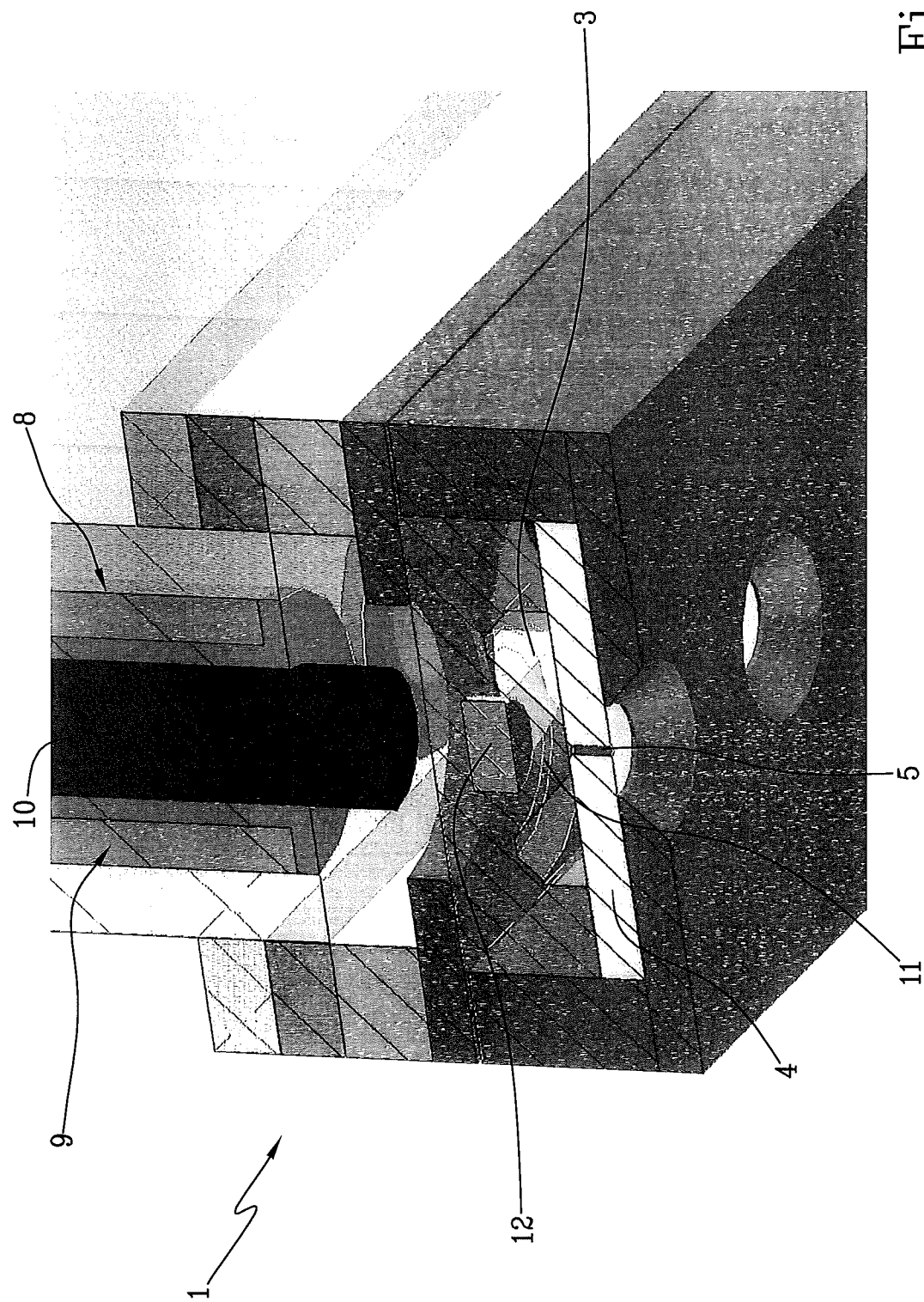


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/053683

A. CLASSIFICATION OF SUBJECT MATTER

INV. B41J2/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B41J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2011 201225 A (SEIKO EPSON CORP) 13 October 2011 (2011-10-13)	1-4,7-11
Y	paragraphs [0080] - [0087]; figures 11-12 -----	5,6
X	US 5 356 034 A (SCHLUMBERGER HELMUT [DE]) 18 October 1994 (1994-10-18) column 5, line 11 - line 34; figure 3 -----	1,2
Y	EP 1 211 075 A1 (CANON KK [JP]) 5 June 2002 (2002-06-05) figures 7e,10 -----	5,6

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

26 August 2015

Date of mailing of the international search report

09/11/2015

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Authorized officer

Bardet, Maude

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2015/053683

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-11 -----

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-11

inkjet device with a sensitive element arranged within the membrane

2. claims: 12-14

die to manufacture a membrane equipped with a sensitive element

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2015/053683

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