



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.08.2009 Bulletin 2009/32

(51) Int Cl.:
B41J 2/165^(2006.01)

(21) Application number: **08075939.2**

(22) Date of filing: **12.12.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

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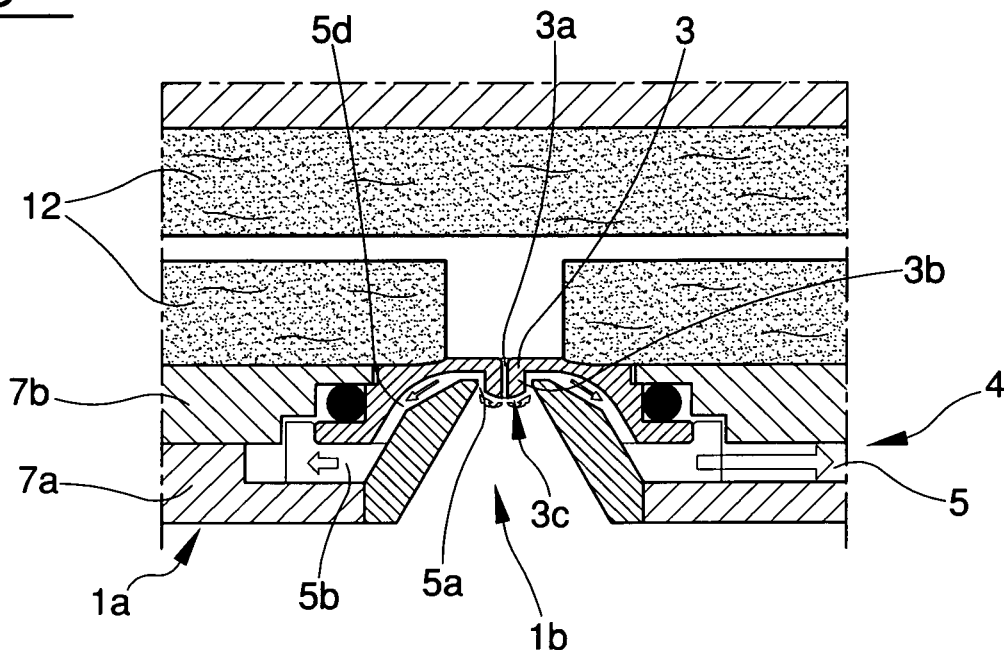
(30) Priority: **30.01.2008 IT MO20080027**

(54) **A printing head with a nozzle-cleaning device and methods for decoration and nozzle-cleaning concerning the printing head**

(57) A printing head (1) for decoration of ceramic products (11) comprising at least a main conduit (1) for containing glaze (10); at least an outlet nozzle (3) provided with an outlet orifice (3a) for the glaze (10) which outlet orifice (3a) is in communication with the main conduit (2); and an integrated cleaning plant (4) of the outlet nozzle (3).

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Fig. 3



Description

[0001] The invention relates to a printing head for decoration of ceramic products, in particular tiles. Further the invention also relates to a method for decorating ceramic products using the printing head and methods for cleaning the nozzles of the printing head.

[0002] In industrial ceramic production, the stage of decorating the product consists in applying coloured ceramic glazes on the surface of the product with the main aim of realising ornamental motifs. The glazes used for decorating are generally suspensions of mineral powders having a more or less refined granulometry.

[0003] To respond to the requirements of flexible productivity peculiar to the ceramic industry, traditional tile decoration methods (silk screening, roto-engraving, flexographic methods, etc) have been augmented by the use of direct ink-jet systems.

[0004] These decorating methods, which use a prevalently similar technology to ink-jet printer devices for paper printing, exhibit some drawbacks connected to the obstruction of the micro-metric orifices of the printing heads, in part due to the moist and dusty atmosphere they have to work in, and mainly due to the glazes used, which are different to the inks normally used for printing on paper. In particular, the glazes must not in any way be applied using glazing systems comprising a solid phase (ceramic) with a granulometry that exceeds a few micrometres.

[0005] Italian patent application no. MO2007A000098 describes a special printing head specially developed for ceramic decorations, also characterised by the increased diameter of the orifices issuing the glaze. Thanks to this peculiarity, the device is able to operate with "traditional" ceramic glazes (suspensions in which a solid phase is present with a granulometry that exceeds even 5 micron) without there being any risk of nozzle obstruction during the printing stage.

[0006] The new printing head as described above is however liable to further improvement in order to resolve some drawbacks and problems in the prior art. Among these is without doubt the very relevant need to maintain the external part of the nozzles continuously clean, which by effect of the ambient conditions in the workplace (dusty and humid) tend to get dirty both during the working stage and also when not actually in use.

[0007] Though the orifices enable a regular flow of the glaze during the operating stages, it is possible and frequent that the side of the nozzles facing the tile to be decorated becomes susceptible to a build-up of dirt, with a consequent risk of partial or complete blocking thereof.

[0008] Even a partial occlusion of the nozzles is absolutely to be avoided, and is at present prevented by periodic cleaning and maintenance operations which require machine shut-down and also the efforts of dedicated personnel, with a consequent increase in plant working costs.

[0009] Further, even when the nozzles are periodically

cleaned, the possible presence of dirt with the formation of encrustation during functioning causes a deterioration in the quality of the print result, and thus has a negative influence on the constancy of the decoration quality produced by the machine and thus has a negative effect on the overall reliability of the machine.

[0010] The aim of the present invention is to obviate the above-mentioned drawbacks in the prior art, and in particular to improve the characteristics of the device described in Italian patent document MO2007A000098.

[0011] An advantage of the device and the methods of the invention is the reduction in maintenance times required for cleaning the nozzles.

[0012] A further advantage of the device and the methods of the invention relates to the reduction in the effort required of the maintenance personnel for cleaning the nozzles.

[0013] A further advantage of the device and the methods described is the improvement in terms of reliability relating to the corresponding devices of the prior art.

[0014] Further characteristics and advantages of the invention will better emerge from the detailed description that follows of preferred though not exclusive realisations thereof, illustrated purely by way of non-limiting example in the accompanying figures of the drawings, in which:

figure 1 is a transversal section of a printing head of the present invention;

figure 2 is an enlarged detail of the transversal section of figure 1 during a stage of the decorating method for ceramic products;

figure 3 is an enlarged detail of the transversal section of figure 1 during the course of a first stage of the method for cleaning nozzles;

figure 4 is an enlarged detail of the transversal section of figure 1 in a second stage of the method for cleaning the nozzles.

[0015] With reference to the figures of the drawings, 1 denotes a printing head of the present invention, preferably to be associated to an in-line decorating machine for ceramic tiles. The device is illustrated in its normal operating configuration, i.e. with the surface onto which the nozzles face orientated downwards. The positional relations between elements of the printing head 1 described herein below in terms of relative heights (for example by the use of the words lower or upper) are to be interpreted as meaning with reference to the operating configuration.

[0016] The printing head 1 for the decoration of ceramic products 11 of the present invention comprises at least a main conduit 2 for containing glaze 10 and at least an outlet nozzle 3, provided with an outlet orifice 3a of the glaze 10 in communication with the main conduit 2. By main conduit 2, reference is made to any cavity which contains glaze 10 or through which glaze 10 transits; in general, printing devices of the described type are provided with glaze supply circuits and the main conduit 2

identifies the branch of the circuit contiguous to the outlet nozzle 3. In realised applications, the outlet nozzles 3 are generally a plurality. The printing head 1 preferably exhibits (though not necessarily) the technical characteristics described in Italian patent M02007A000098. The device of the present description is different to the prior art in that it comprises an integrated cleaning plant 4 of the outlet nozzle 3.

[0017] The presence of the integrated cleaning device 4 achieves the above-identified aim of the invention, as it enables an effective automated cleaning of the at least an outlet nozzle 3 in a way which will be fully explained herein below.

[0018] In the preferred embodiment of the invention, the integrated cleaning plant 4 comprises at least a second conduit 5, which communicates with the outside of the printing head 1 by means of at least a mouth 5a arranged in proximity of the outlet orifice 3a. The secondary conduit 5 is advantageously predisposed for continuously aspirating any impurities which might be deposited on the external part of the outlet nozzle 3. The described elements preferably correspond to the outlet nozzles 3 of the device; thus for each nozzle there is a secondary conduit 5 having a mouth 5a in proximity of the outlet orifice 3a.

[0019] The main conduit 2 and the secondary conduit 5, at least in a printing configuration (i.e. during the course of normal functioning of the machine to which the printing head is associated) are preferably not in mutual direct fluid communication; the glaze supply circuit and the cleaning circuit of which the at least a second conduit 5 is a part are therefore distinct from one another. By keeping the two conduits (or circuits) separate, it is possible to keep the fluid movements operated internally thereof independent of one another, thus enabling the outlet nozzle 3 cleaning systems described herein below to be operated.

[0020] In the example, the two circuits can be separated by special selector valves, such as to facilitate management of the integrated cleaning plant 4 in the second nozzle-cleaning method described.

[0021] In particular, to enable the described fluid movements in the second conduit 5, the device comprises means for moving the fluid 20 through the secondary conduit 5. The means for moving the fluid 20 advantageously comprise an aspirator, a compressor or an aspirator compressor preferably arranged on a common manifold channel 6 connected to a plurality of secondary conduits 5.

[0022] The following descriptions of the morphology of the integrated cleaning plant 4 relating to the illustrated embodiment of the invention refer for the sake of simplicity to a single outlet nozzle 3. In normal applications of the invention, as stated above, the outlet nozzles 3 will be a plurality; the following described characteristics preferably relate to each of the nozzles making up the aforementioned plurality.

[0023] In the illustrated embodiment of the printing

head 1, the mouth 5a develops annularly and surrounds the outlet nozzle 3. The outlet nozzle 3 comprises at least a projecting portion 3b which develops longitudinally projectingly with respect to the plane identified by the mouth 5a. The projecting portion 3b is preferably cylindrical. At the lower end thereof it exhibits a directing surface 3c onto which the outlet orifice 3a opens. The directing surface 3c is preferably convex such as to facilitate the fluid flow towards the mouth 5a. In the illustrated example, the directing surface 3c is a spherical dome shape and the outlet orifice 3a opens out at the lowest point of the dome.

[0024] The printing head 1 exhibits a lower surface 1a, predisposed to be positioned operatively above a ceramic product 11 to be decorated, preferably a ceramic tile. The lower surface 1a is the active surface of the printing head 1 and is provided with the outlet nozzles 3 for emitting the glaze 10 onto the ceramic product 11. The surface exhibits at least a concavity 1b for housing the projecting portion 3b of the outlet nozzle 3; the concavity 1b is superiorly delimited by the mouth 5a. The lower surface 1a preferably exhibits a concavity 1b for housing each of the outlet nozzles 3b. The projecting portion 3b of the outlet nozzles 3 is completely housed internally of the concavity 1b and does not project with respect to the lower surface 1a. In the illustrated embodiment, the concavity 1b exhibits a truncoconical shape.

[0025] The above-described configuration of the integrated cleaning plant 4 has been designed to perform the specific function of the device. In particular, the shape of the projecting portion 3b of the outlet nozzle 3, of the mouth 5a and the concavity 1b serve the objective of improving the efficiency of the plant during the stages of decoration and cleaning, as described herein below.

[0026] As mentioned above, the printing head 1 of the present invention comprises a common manifold channel 6 and a plurality of secondary conduits 5. Each of the secondary conduits 5 comprises an annular chamber 5b, in direct fluid communication with a respective mouth 5a, and a connecting channel 5c connecting the annular chamber 5b to the common manifold channel 6. In particular, the annular chamber 5b internally extends about the volume of the concavity 1b. The annular chamber 5b is arranged at a lower height than the mouth 5a. A hemispherical interspace 5d places the annular chamber 5b and the mouth 5a in communication. The connecting channel 5c visible in the figures is composed of a horizontal tract communicating with the annular chamber 5b and a vertical tract directed to the common manifold channel 6. The common manifold channel 6 extends longitudinally along the development direction of the printing head 1, i.e. along a perpendicular direction to the planes identified by the connecting channels 5c described. The totality of the secondary conduits 5 and the common manifold channel 6 defines the cleaning circuit to which reference has been made herein above.

[0027] From the constructional point of view, the printing head 1 of the present invention preferably comprises

a lower plate 7a and an upper plate 7b solidly associated to one another to define the lower part of the head 1. The annular chamber 5b and at least a part of the connecting channel 5c are defined between the plates. In particular, the lower plate 7a exhibits a truncoconical recess having a central hole defining the concavity 1b for housing the projecting portion 3b of the outlet nozzle 3. The upper plate 7b is instead solidly connected to the outlet nozzle 3 and crossed thereby.

[0028] The truncoconical recess of the lower plate 7a can be defined by a holed capsule 7c, with an internal truncoconical surface and an external hemispherical surface, associated to a laminar body. The internal surface of the capsule 7c laterally delimits the cavity 1b; the external surface defines a wall of the hemispherical interspace 5d. The other wall of the hemispherical interspace 5d is defined by a complementarily-shaped element with respect to the capsule 7; it can be a portion of the upper plate 7b or alternatively an insert therein, which can be realised in a single piece with the body of the outlet nozzle 3, as in the illustrated embodiment.

[0029] The above-described integrated cleaning plant 4 exhibits various functioning modes. These functioning modes, described herein below, are complementary in guaranteeing a perfect cleanliness of the outlet nozzles 3 of the printing head 1 and consequently ensure a high level of device reliability.

[0030] In the first functioning mode, the integrated cleaning device 4 operates during the functioning of the printing head 1. An object of the present invention is a method for decorating ceramic products 11, and in particular ceramic tiles, by means of the described printing head 1. The method comprises the following stages: at least a stage of emitting droplets of glaze 10 through the at least an outlet nozzle 3 and at least a stage of continuous aspiration of any impurities which might be deposited on the external part of the outlet nozzle 3 through the second conduit 5. The method can advantageously comprise a stage of regulating the intensity of the aspiration without influencing the trajectory of the droplets of glaze 10 emitted during the printing stage.

[0031] In terms of application, during the normal functioning of the printing head 1, the aspirator (or compressor aspirator, or pump) which constitutes the means for moving the fluid 20 is kept in operation and aspirates, through the second conduit 5 and the manifold channel 6 if present, the solid or liquid impurities which otherwise would be deposited at the outlet of the outlet orifice 3. The mouth 5a thus functions as an aspirating mouth of the cleaning circuit. A correct adjustment of the compressor aspirator prevents the droplets of glaze 10 from deviating; thanks to this detail, the aspiration does not influence the printing quality of the machine. The functioning of the device according to the described modalities is represented in figure 2.

[0032] The other functioning modes of the integrated cleaning plant relate to methods for cleaning with the machine shut down, i.e. when the machine is not deco-

rating or printing.

[0033] A first method for cleaning the printing head 1 of the invention comprises: a stage of conveying a cleaning fluid 12 internally of the main conduit 2; a stage of expelling the cleaning fluid 12 through the outlet nozzle 3 and a stage of aspirating the cleaning fluid 12 expelled from the outlet orifice 3a through the secondary conduit 5. In these stages, the aspirator (or compressor aspirator) is regulated such as to aspirate all of the fluid exiting from the outlet orifice 3a of the outlet nozzle 3. In this case too the mouth 5a functions as an aspirating mouth of the cleaning circuit. The described method, which first requires an emptying of the glaze supply circuit, enables total cleaning of the inside of the printing head 1, the outlet orifice 3a and the directing surface 3c which is struck by the cleaning fluid 12. The functioning of the device in the described mode is illustrated in figure 3.

[0034] A second mode, complementary to the first, for cleaning the printing head 1, comprises stages of conveying, preferably by means of the compressor or the compressor aspirator (or a pump) which constitute the means for moving the fluid 20, a cleaning fluid 12 through the secondary conduit 5 towards the mouth 5a and expelling the cleaning fluid 12 through the mouth 5a, which functions in this case as a blower mouth. In this method, the secondary conduit 5 is cleaned of the residues aspirated during the stage of decorating or during the first cleaning method; further, and thanks to the special conformation of the blower mouth 5a and the outlet nozzle 3, the external surface of the projecting portion 3b of the outlet nozzle 3 is also carefully cleaned. During the course of the washing stages performed in the present operating mode, a collection tray can be placed below the lower surface 1a of the device for collecting the cleaning fluid 12. The functioning of the device according to the described mode is illustrated in figure 4.

[0035] In both above-described washing methods with the machine stationary the cleaning fluid 12 can be constituted simply by water, or by a detergent fluid suitable for this particular use.

Claims

1. A printing head (1) for decoration of ceramic products (11) comprising at least a main conduit (1) for containing glaze (10); at least an outlet nozzle (3) provided with an outlet orifice (3a) for the glaze (10) which outlet orifice (3a) is in communication with the main conduit (2); **characterised in that** it comprises an integrated cleaning plant (4) of the outlet nozzle (3).
2. The printing head (1) of claim 1, **characterised in that** the integrated washing plant (4) of the outlet nozzle (3) comprises at least a secondary conduit (5), communicating with an outside of the printing head (1) by means of at least a mouth (5a) arranged

in proximity of the outlet orifice (3a), the secondary conduit (5) being predisposed to aspirate solid or liquid impurities which might be deposited on the external parts of the outlet nozzle (3).

3. The printing head (1) of claim 2, **characterised in that** the mouth (5a) develops annularly, surrounding the outlet nozzle (3).
4. The printing head (1) of claim 3, **characterised in that** the outlet nozzle (3) comprises at least a projecting portion (3b) which develops longitudinally projectingly with respect to the plane identified by the mouth (5a).
5. The printing head (1) of claim 4, **characterised in that** the projecting portion (3b) of the outlet nozzle (3) exhibits, at a lower end thereof, a directing surface (3c) onto which the outlet orifice opens (3a), the directing surface (3c) being convex in order to facilitate flow of the fluid towards the mouth (5a).
6. The printing head (1) of claim 5, **characterised in that** it exhibits a lower surface (1a) predisposed to be positioned operatively above a ceramic product (11) to be decorated, the surface exhibiting at least a concavity (1b) for housing the projecting portion (3b) of the outlet nozzle (3), the concavity (1b) being superiorly delimited by the mouth (5a).
7. The printing head (1) of one of claims from 3 to 6, **characterised in that** it comprises a common manifold channel (6) and a plurality of secondary conduits (5) each comprising an annular chamber (5b) in direct fluid communication with a respective mouth (5a) and a connecting channel (5c) connecting the annular chamber (5b) to the common manifold channel (6).
8. The printing head of claim 7, **characterised in that** in an operating configuration the annular chamber (5b) is arranged at a lower level than the mouth (5a).
9. The printing head of one of claims 7 or 8, when depending on claim 6, **characterised in that** it comprises a lower plate (7a) and an upper plate (7b) associated solidly to one another to define the lower part of the printing head (1); the annular chamber (5b) and at least a part of the connecting channel (5c) being defined between the plates; the lower plate (7a) exhibiting a truncoconical recess exhibiting a central hole defining the concavity (1b) for housing the projecting portion (3b) of the outlet nozzle (3); the upper plate (7b) being solidly connected to the outlet nozzle (3) and crossed thereby.
10. The printing head of one of claims from 2 to 9, **characterised in that** the main conduit (2) and the sec-

ondary conduit (5), at least in a printing configuration, are not in direct fluid communication with one another.

- 5 11. The printing head of one of claims from 2 to 10, **characterised in that** it comprises means for moving fluid (20) through the secondary conduit (5).
- 10 12. The printing head of claim 11, **characterised in that** the means for moving the fluid (20) are constituted by an aspirator.
- 15 13. The printing head of claim 11, **characterised in that** the means for moving the fluid (20) are constituted by a compressor or by a pump.
- 20 14. The printing head of claim 11, **characterised in that** the means for moving the fluid (20) are constituted by a compressor aspirator.
- 25 15. A method for decorating ceramic products (11) by means of the printing head (1) of one of claims from 2 to 14, comprising at least a stage of emission of droplets of glaze (10) through the outlet nozzle (3), **characterised in that** it comprises at least a stage of aspirating any solid or liquid impurities which might be deposited on external parts of the outlet nozzle (3) through the secondary conduit (5).
- 30 16. The method for decorating ceramic products (11) of claim 15, **characterised in that** it comprises a stage of regulating an intensity of the aspiration without influencing a trajectory of the drops of glaze (10) emitted during the printing stage.
- 35 17. A method for cleaning a printing head (1) of one of claims from 2 to 14, **characterised in that** it comprises a stage of conveying a cleaning fluid (12) internally of the main conduit (2), a stage of expelling the cleaning fluid (12) through the outlet nozzle (3) and a stage of aspirating the cleaning fluid expelled from the outlet orifice (3a) of the outlet nozzle (3) through the secondary conduit (5).
- 40 18. The method for cleaning a printing head (1) of one of claims from 2 to 14, **characterised in that** it comprises a stage of conveying a cleaning fluid (12) through the secondary conduit (5) towards the mouth (5a) and a stage of expelling the cleaning fluid (12) through the mouth (5a).
- 45 50 55

Fig. 1

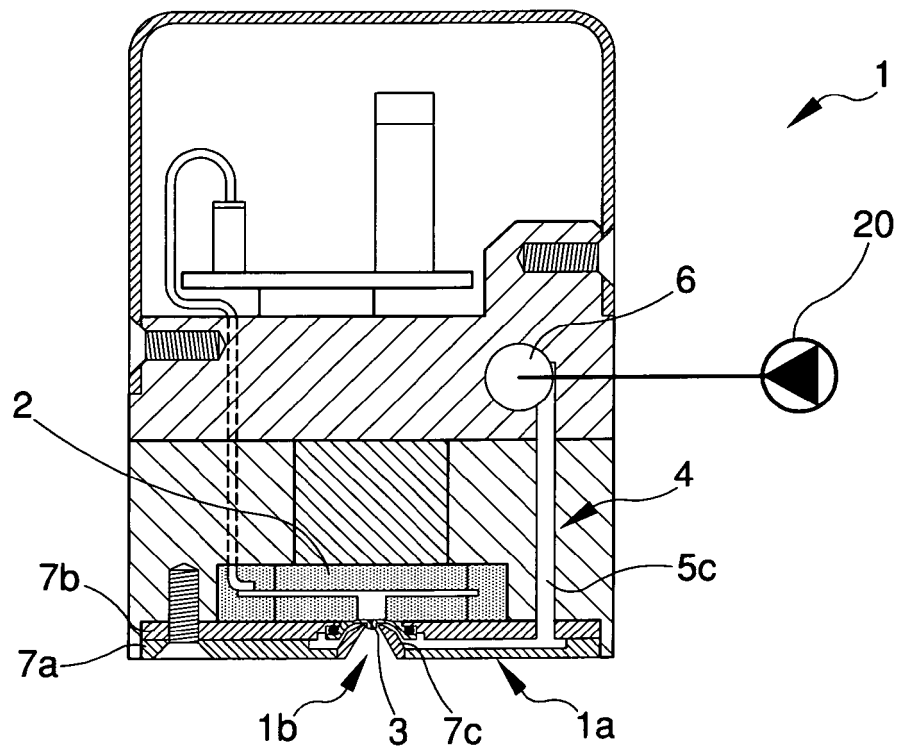


Fig. 2

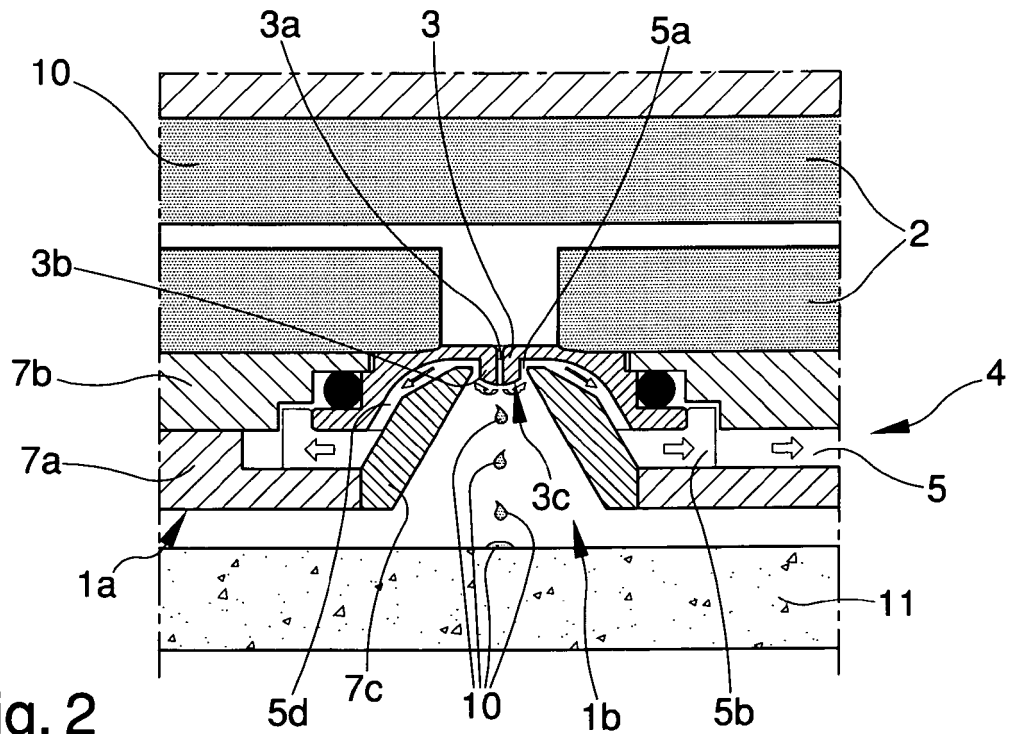


Fig. 3

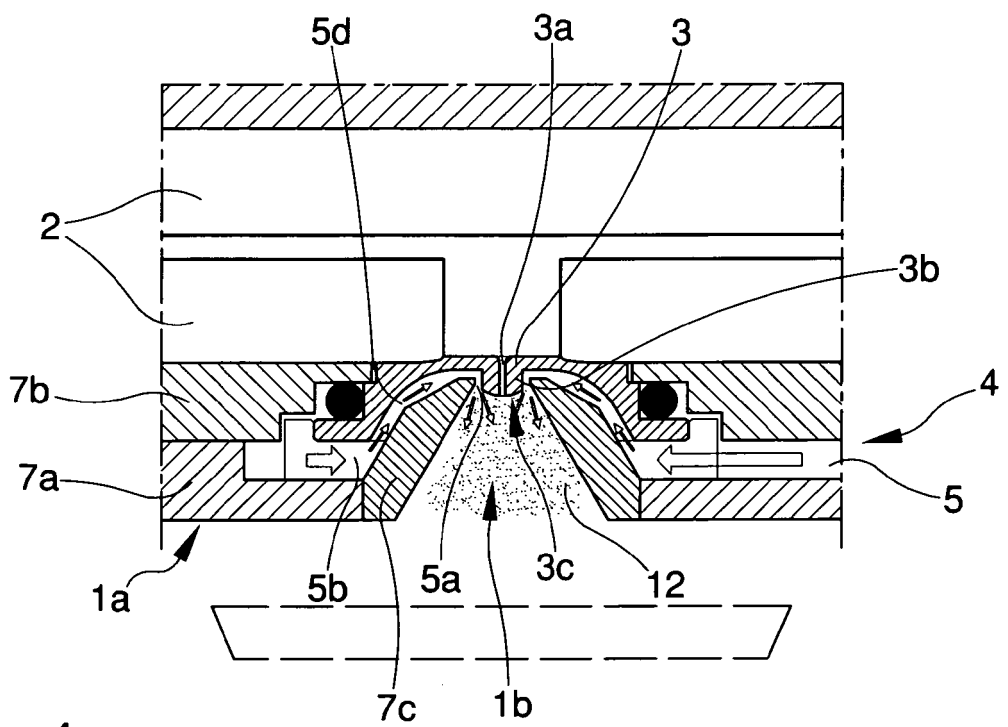
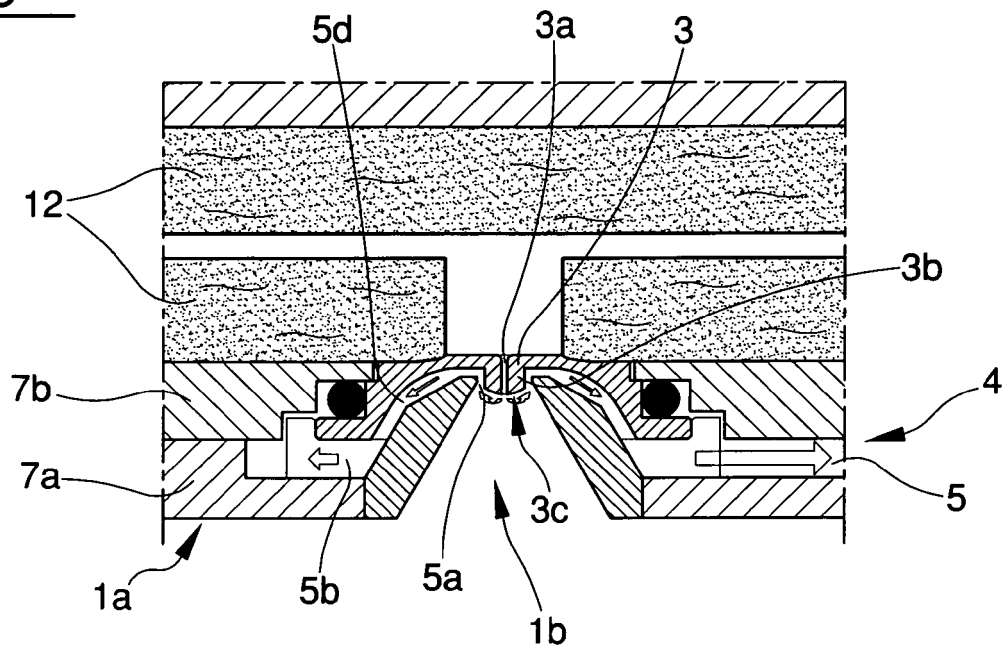


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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