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(54) Device for moving a fluid

(57) The invention relates to a device for moving fluid likely to be used in the ink jet printing art.

The device as claimed in the invention includes means for moving fluid using polymers whose hydrophilic or hydrophobic properties can be selected under the action of an external stress.

Application to ink jet heads.

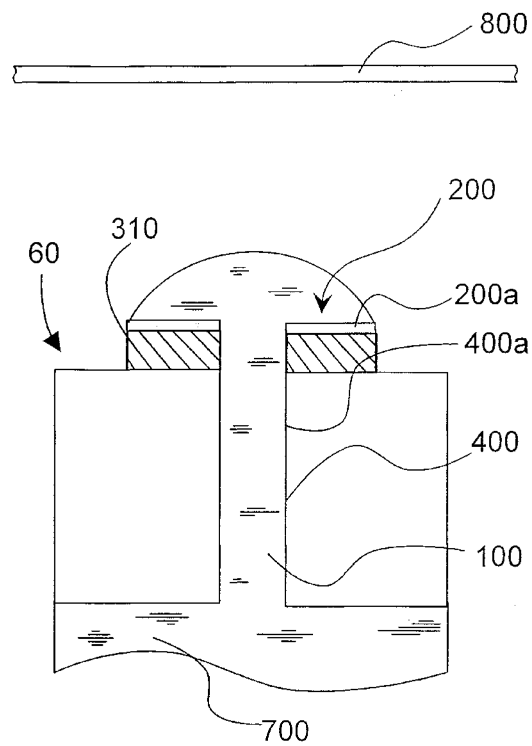

FIGURE 5A

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Description

[0001] The present invention relates to a device for moving a fluid, a device capable of being used especially in an ink jet printer.

[0002] In ink jet printing technology, the main concerns are to improve the quality as well as the speed of printing.

[0003] The objective of almost all the printing technologies developed at present is to produce high quality copies as fast as possible. For ink jet technologies, to achieve fast printing, the various manufacturers increase the number of nozzles on the surface of the heads which are capable of ejecting ink drops in order to print a greater number of points in parallel on the receiving medium. However, the number of nozzles on the surface of the head is limited either because of problems related to heat dissipation in the methods consisting in using high temperature ink, as in the technologies developed by Canon and Hewlett Packard, or because of problems related to dimensional instability due to vibrations caused by the use of piezoelectric technologies, as those developed by Seiko-Epson.

[0004] One of the technologies traditionally used in ink jet heads consists in raising the ink found in a channel to a high temperature in a short time, typically 300 to 400°C. This causes local vaporization of the ink which causes the expulsion as drops of the liquid part of the ink found between the vaporization zone and the surface of the ink jet head. This method requires thermal energy in the volume of the ink jet head itself, which must then be dissipated.

[0005] Other techniques, for example those described in Patent Application WO96/32284, consist in bringing a fluid into contact with a ring shaped heating element located at the periphery of the opening of a channel linking a reservoir containing the fluid to the opening on the surface of the ink jet head. Pressure is applied to the reservoir in order to allow the ink to be sent through the channel and to spread over the heating ring surface of the ink jet head.

[0006] When the heating element of the ink jet head is raised to a temperature of about 130°C, there are significant changes to the surface tension of the ink drop in contact with the heating element. The surface tension change causes a decrease in the radius of curvature of the ink drop meniscus thus allowing it to run freely through the channel and to form a drop of the appropriate size for the printing required. Once formed, this drop is then ejected by means that can be an electrostatic field between the ink jet head and the printing medium, for example a sheet of paper. This technique, which has the advantage of considerably lowering the temperature needed to eject a unit volume of ink, is thus more appropriate to the manufacture of highly integrated ink jet heads. However, while in theory it is necessary only to heat the surface of the ink drop meniscus to get the change in its radius of curvature and thus to get the formation of the said ink drop, in practice it is necessary to heat the whole volume of the ink drop which requires a much higher energy supply to eject an ink drop. However, it should be noted that as the ink is heated in its volume, part of the energy supplied to get the ink drop is still contained in it on ejection; this makes the dissipation of this energy easier, as it does not stay confined in the ink jet head itself.

[0007] It is an object of this invention to provide a device for moving a fluid, for example ink, which minimizes the amount of energy required to eject a drop of this fluid.

[0008] Such a device allows a fluid to be ejected out of a channel, and allows fluid with an accurately set volume to be ejected.

[0009] These objects are achieved according to the present invention, which relates to a device for moving a fluid, characterized in that it comprises fluid moving means comprised of polymers, whose hydrophilic or hydrophobic properties can be selected under the action of an external stress.

[0010] The invention also relates to a process for moving a fluid, this process involving the use of a polymer whose hydrophilic or hydrophobic properties can be selected under the action of an external stress in a device for moving this fluid.

[0011] The invention also relates to a printing fluid jet head that includes:

a) at least one means of feeding the printing fluid;
b) at least one channel terminated by a nozzle opening to the outside;

characterized in that it further includes:
c) means for moving the printing fluid comprising polymers whose hydrophilic or hydrophobic properties can be selected under the action of an external stress.

[0012] All the embodiments of this invention, which will be described below, are used to move a hydrophilic fluid. However, when the fluid to be ejected is hydrophobic, the embodiments described below are applied using appropriate polymers. For example, polymers can be chosen which are in their hydrophobic state when they are not subject to an external stress and in their hydrophilic state when they are subject to an external stress.

[0013] Other characteristics will appear on reading the description below, with reference to the drawing wherein:

- Figure 1A represents a polymer element in a hydrophilic state on which there is a drop of hydrophilic fluid;
- Figure 1B represents a polymer element in a hydrophobic state on which there is a drop of hydrophilic fluid;
- Figure 2 represents a polymer element provided with a means to generate an external stress;
- Figure 3 represents a channel for ejecting a fluid

provided with the means to move the fluid according to the invention, the polymer element being in a hydrophilic state;

- Figure 4 represents a channel for ejecting a fluid provided with the means to move the fluid according to the invention, the polymer element being in a hydrophobic state;
- Figure 5A represents a portion of a print fluid jet head provided with the means to move the fluid according to the invention, the polymer element being in a hydrophilic state;
- Figure 5B represents a portion of a print fluid jet head provided with the means to move the fluid according to the invention, the polymer element being in a hydrophobic state;
- Figure 6 represents a second embodiment of a print fluid jet head provided with the means to move the fluid according to the invention;
- Figure 7 represents a third embodiment of a print fluid jet head provided with the means to move the fluid according to the invention; and
- Figure 8 represents a fourth embodiment of a print fluid jet head provided with the means to move the fluid according to the invention.

[0014] In general, the technique used to move a fluid 10 according to the present invention consists in using a polymer element 20 whose hydrophilic or hydrophobic properties can be selected under the action of an external stress. The polymer element 20 can be in a hydrophilic state 20a or in a hydrophobic state 20b. The principle is to have an element 20 composed of such polymers in contact with the fluid 10 that is to be moved. When the polymer is in its hydrophilic state 20a, as represented in Figure 1A, the fluid 10 tends to stay in contact with the polymer element. However, when the polymer is switched to its hydrophobic state 20b, as represented in Figure 1B, the fluid 10 tends to be repelled and therefore to form a drop on the surface of the polymer element. Thus, the switching of the polymer from one state to the other causes movement of the fluid.

[0015] Depending on the polymer selected, the external stress necessary to switch it from one state to the other can be determined, and therefore the means to generate the external stress.

[0016] When thermo-reversible polymers are selected, that is polymers which, when their temperature exceeds a threshold temperature called the phase transition temperature, switches from a hydrophilic state to a hydrophobic state or vice-versa, the external stress will be the application of thermal energy. Preferably thermo-reversible polymers should be chosen that have a phase transition temperature between 20 and 100°C, and preferably between 30 and 70°C.

[0017] Figure 2 represents a polymer element 20 provided with the means 30 to generate the external stress, that is in this case, thermal energy. The means 30 are made up of a temperature control element, for example, a heating element 31 placed below the polymer element. The heating element is made up for example with a thin layer of polycrystal silicon wherein a current is made to flow that is adapted to the generation of a quantity of thermal energy that allows the polymer to exceed its phase transition temperature to switch from one state to the other. The polymer element can then return to its initial state, its temperature having decreased by the simple diffusion of the heat. Also an additional cooling system can be provided such as for example a radiator or a Pelletier effect device.

[0018] The thermo-reversible polymers, which are used in the present device, are organic polymers such as those described in Patent Application WO 91/15526. These are polymers that have a hydrophilic group and a hydrophobic group, the hydrophilic group being a water-soluble ionic polymerizable vinyl monomer, and the hydrophobic group comprising an acrylamide or methacrylamide monomer. For example a poly(N-alkylacrylamide), a modified glycol polyethylene or a polysilylamine will be chosen. Preferably a polymer will be used that switches from one state to the other very fast, for example poly(N-isopropylacrylamide).

[0019] To make the polymer element 20 switch from its hydrophilic state to its hydrophobic state, it has to exceed a hydrophilic/hydrophobic phase transition temperature Tg proper to the polymer. Poly(N-isopropylacrylamide) has a temperature Tg of about 32°. When the polymer is at a temperature less than 32°, it is hydrophilic. When it is higher than 32°, it becomes hydrophobic. In addition, the hydrophilic/hydrophobic phase transition temperature of a polymer can be modified by different means. For example adding a surfactant to the fluid to be carried can increase the phase transition temperature. This technique is described in the publication, Langmuir, 1995, volume 11, No. 7, pages 2493-2495. For example the phase transition temperature Tg of poly (N-isopropylacrylamide) can be modified from 32°C to 90°C.

[0020] Electrically conductive organic polymers can be chosen, for example polymethylethiophene, which under the action of an electric current as an external stress switches from the hydrophilic state to the hydrophobic state or vice-versa. The means to generate the external stress in this case are means to apply an electric current to the polymer element.

[0021] Depending on the polymer selected, other external stresses can be used such as for example, a pH change, an ionic strength change or a pressure. For each polymer, the means suitable to generate the said stress will be determined by those skilled in the art who know the stress necessary to switch the polymer from the hydrophilic state to the hydrophobic state.

[0022] For the relevant polymers, it is known that the hydrophilic/hydrophobic state change causes the polymer's volume to vary. However, it is preferable to cope with these volume variations. Also, how to control the volume variations of polymers that can switch from a hydrophilic to a hydrophobic state is known. Therefore, known techniques such as those described in Polymer Communications, "Synthesis of fast response, temperature-sensitive poly(N-isopropylacrylamide) gel", can be used.

[0023] In the embodiments, which will be described, the polymers used are thermo-reversible polymers.

[0024] Figures 3 and 4 represent a channel 40 filled with a fluid 10. In order to move the fluid 10 out of the channel 40, means 20, 30 are provided for moving the fluid 10 along the internal wall of the channel 40, close to the end 40a of the channel. The moving means include a polymer element 20 whose hydrophilic or hydrophobic properties can be selected under the action of thermal energy. The polymer element 20 can be in a hydrophilic state 20a or hydrophobic state 20b. The said moving means also include means to control the temperature, which are the heating means 31 for the polymer element 20. The heating means 31 are the same as those described for Figure 2. The polymer element 20 is covered by the heating means. The polymer element can then be heated to exceed a threshold temperature, which is the polymer's phase transition temperature. In the device represented in Figure 3, the polymer element 20 is represented in its hydrophilic state 20a. The fluid 10 is uniformly distributed throughout the channel 40. Figure 4 represents the polymer element 20 in its hydrophobic state 20b. In this case, the fluid 10 found at the hydrophobic polymer element 20b tends to be repelled by this element, an empty volume 50 thus being created inside the channel 40. The volume of fluid that was found between the polymer element 20 and the end 40a of the channel is an independent volume of fluid that is moved out of the channel. In order to prevent the return of the fluid into the means of feeding the fluid, the feeding means can be maintained under pressure by any means known to those skilled in the art.

[0025] In a preferred embodiment of the invention, the fluid to be moved by the device according to the invention is a printing fluid, for example printing ink, or a thermopolymer which allows three-dimensional printing in stereolithographic processes.

[0026] Figures 5A and 5B represent a portion of a fluid jet head 60 for printing on a support 800 which comprises a means of feeding 700 the printing fluid, a channel 400 for moving the fluid 100 outwards. In particular, when the fluid is ink 100, the device for moving the fluid according to the invention is an ink jet head. The channel 400 ends in a nozzle 400a open to the outside. The periphery of the nozzle 400a is provided with a polymer element 200. The polymer element 200 can be in a hydrophilic state 200a or in a hydrophobic state 200b. Such an element is provided to create an ink drop 100, thus allowing the ink 100 to be ejected. The polymer element 200 is preferably a very thin layer. The means for controlling the temperature are heating means 310 such as those described above. The said means of heating 310 are provided below the polymer element 200.

[0027] Figure 5A represents the portion of the ink jet head when the polymer element is in its hydrophilic state 200a. As the means of feeding 700 the ink always being maintained under pressure to prevent the ink from returning into the feeding means 700, the inks tends to come and stay in contact with the polymer element 200a. When the polymer element switches to its hydrophobic state 200b as is represented in Figure 5B, the ink tends to go away from the polymer element 200b. Since the means for feeding the ink is maintained under pressure, the ink cannot return to the feeding means 700 and an ink drop forms. The ink drop 100 can then be ejected by any means known to those skilled in the art. For example an electrostatic field can be applied as described in Patent Application WO 96/322284.

[0028] In a variant of this embodiment, the polymer element is provided not at the periphery of the nozzle but along the internal wall of the channel 400, close to the nozzle 400a. The polymer element is preferably ring-shaped. In this embodiment, an element at the periphery can also be used to allow the ink to be ejected. For example, if the fluid is hydrophilic, the element will be a hydrophobic polymer element.

[0029] Figure 6 represents another embodiment of the ink jet head 60 according to the invention. A first polymer element 200 is provided at the periphery of the nozzle 400a and a second polymer element 201 is provided along the internal wall of the channel 400. The polymer element 201 is preferably ring-shaped. Heating means 310 and 311 are provided to heat the polymer elements 200 and 201 respectively. In this embodiment, the volume of the drop to be ejected can be determined. The polymer elements 200 and 201 are initially in a hydrophilic state. When a volume of ink required to form a drop is obtained, the polymer element 201 is heated and switches to its hydrophobic state. The volume of ink is moved out of the channel 400. Then the polymer element 200 is switched to its hydrophobic state in order to allow the ink drop to be ejected. Since the polymer element 201 is maintained in its hydrophobic state, the ink drop cannot return to the channel 400.

[0030] According to another embodiment represented in Figure 7, heating means, not illustrated, are provided to heat, not the polymer element directly, but the ink 100 in the means for feeding the ink 700. A polymer element 200 is provided at the periphery of the nozzle 400a. To prevent the ink drop that forms at the periphery of the nozzle 400a from spreading over the whole external surface of the ink jet head 60, the materials of the external surface of the ink jet head are planned to be hydrophobic. The ink will therefore not tend to spread beyond the polymer element 200.

[0031] The ink 100 is heated to a temperature T higher than the phase transition temperature Tg of the polymer element 200. When the ink 100 leaves the nozzle 400a at the temperature T, it is in contact with the polymer element 200. The heat of the ink is transferred to the polymer element 200, which exceeds its phase transition temperature Tg. Then the polymer element 200 switches to its hydrophobic state 200b. The wetting angle of the ink 100 increases, therefore creating an ink drop 100. The ink drop 100 can then be ejected in the same way as described in the embodiment represented in Figure 5B. When the heating means is not activated, the ink 100 has a temperature less than the phase transition temperature of the polymer element 200, which is therefore in its hydrophilic state 200a. In this case, the ink cannot form a drop at the surface of the ink jet head, and therefore there is no ejection. In addition, in order to prevent the ink jet head from blocking because of ink drying at the channel opening, the pressure maintained in the feeding means can be decreased or canceled in order to return the ink into the feeding means.

[0032] A ring-shaped polymer element 201 is advantageously provided inside the channel 400 so as to control the ejection of the ink 100. Figure 8 represents this alternative embodiment. Heating means 311 such as those described in Figure 2 are provided to heat the polymer element 201. The polymer element 201 cover the whole surface area of the heating means 311, so that the whole surface of the polymer element 201 changes state. The phase transition temperature Tg' of the polymers used in the polymer element 201 must be higher than the phase transition temperature Tg of the polymers used in the polymer element 200 and higher than the temperature T of the ink. When ink 100 is not to be ejected, the polymer element 201 is maintained in its hydrophobic state by raising it to a temperature higher than Tg' using the heating means 311. The ink 100 present in the channel 400 is no longer able to run out to the surface of the ink jet head, making all ejection impossible. When the ink 100 is to be ejected, first the polymer element 201 is maintained in its hydrophilic state by not activating the heating means 311. Therefore the ink 100 can run freely out to the surface of the ink jet head. As the ink temperature T is higher than the phase transition temperature Tg of the polymer element 200, it follows that on contact with the ink, this polymer element 200 will switch from the hydrophilic state to the hydrophobic state and therefore allow an ink drop to form on the surface of the head. The polymer element 201 can then be raised to its hydrophobic state by activating the heating means 311 which stops the flow of ink in the channel 400 and therefore allows the volume of ink to be ejected to be accurately selected. When the drop thus formed has been ejected, the polymer element 200, which is no longer in contact with the heated ink, returns to its hydrophilic state. In order to be able to restart the ejection cycle of an ink drop, the heating means 311 is deactivated, which allows the polymer element 201 to return to its hydrophilic state and therefore allows the ink 100 to run freely in the channel 400 out to the surface of the ink jet head.

Claims

1. A device for moving a fluid (10) characterized in that it includes means for moving the fluid (10) comprised of polymers whose hydrophilic or hydrophobic properties can be selected under the action of an external stress.

2. A device as claimed in Claim 1 wherein the means for moving the fluid (10) include, on the one hand, at least one polymer element (20) whose hydrophilic or hydrophobic properties can be selected under the action of an external stress, and on the other hand, means (30) to generate the said external stress.

3. A device as claimed in any one of the preceding claims wherein the fluid (10) is moved in a channel (40).

4. A device as claimed in Claim 3 wherein the polymer element (20) is provided along the internal wall of the channel (40).

5. A device as claimed in Claim 4 characterized in that the polymer, whose hydrophilic or hydrophobic properties can be selected under the action of an external stress, is a thermo-reversible polymer.

6. A device as claimed in Claim 5 wherein the means (30) to generate the said external stress are means to control the temperature.

7. A device as claimed in Claim 6 wherein the means to control the temperature include a resistance (31) in contact with the polymer element (20), the said resistance being fed by an electrical circuit.

8. A device as claimed in Claim 4 wherein the polymer whose hydrophilic or hydrophobic properties can be selected under the action of an external stress is an electrically conductive organic polymer.

9. A device as claimed in Claim 8 wherein the means (30) to generate the said external stress are means to apply an electric current.

10. A device as claimed in any one of the preceding claims characterized in that it further includes:

    1) at least one means for feeding fluid;
    2) at least one fluid receiver.

11. A printing fluid jet head (60) comprising:

    a) at least one means (700) for feeding printing fluid;
    b) at least one channel (400) terminated by a

nozzle (400a) open to the outside; characterized in that it further includes:
c) means for moving the printing fluid (100) that comprise polymers whose hydrophilic or hydrophobic properties can be selected under the action of an external stress.

12. A printing fluid jet head (60) as claimed in Claim 11 wherein the said means for moving the printing fluid (100) include, on the one hand, at least one polymer element (200) whose hydrophilic or hydrophobic properties can be selected under the action of an external stress, and on the other hand, means to generate the said stress.

13. A printing fluid jet head (60) as claimed in Claim 12 wherein a polymer element is provided either at the periphery of the opening of the nozzle (400a), or along the internal wall of the channel (400), or at the periphery of the opening of the nozzle (400a) and along the internal wall of the channel (400).

14. A fluid jet head as claimed in Claim 13 wherein when a polymer element is provided along the internal wall of the channel (400), an element is provided at the periphery of the nozzle (400a) in a state to allow fluid (100) to be ejected.

15. A printing fluid jet head (60) as claimed in Claim 13 wherein the polymer element (201) provided along the internal wall of the channel (400) is located close to the opening of the nozzle (400a).

16. A printing fluid jet head (60) as claimed in any one of the Claims 11 to 15 wherein the polymer whose hydrophilic or hydrophobic properties can be selected under the action of an external stress is a thermo-reversible polymer.

17. A printing fluid jet head (60) as claimed in Claim 16 wherein the means to generate the said external stress are means to control the temperature.

18. A printing fluid jet head (60) as claimed in Claim 17 wherein the means to control the temperature include resistances fed by an electrical circuit, each polymer element being in contact with one resistance.

19. A printing fluid jet head (60) as claimed in Claim 17 wherein the means to control the temperature are provided to control the temperature of the printing fluid (100) in the feeding means (700) for the printing fluid.

20. A printing fluid jet head (60) as claimed in Claim 19 wherein when one polymer element is provided at the periphery of the opening of the nozzle (400a) and along the internal wall of the channel (400), the means to control the temperature include a resistance (311) in contact with the polymer element provided along the internal wall of the channel (400).

21. A printing fluid jet head (60) as claimed in any one of the Claims 11 to 15 wherein the polymer is an electrically conductive organic polymer.

22. A printing fluid jet head (60) as claimed in Claim 21 wherein the means to generate the external stress are means to apply an electric current.

23. Fluid jet head as claimed in any one of the Claims 11 to 22 wherein the fluid is ink.

24. Use of a polymer whose hydrophilic or hydrophobic properties can be selected under the action of an external stress in a printing fluid jet head as claimed in any one of the Claims 11 to 23.

25. Use of a polymer whose hydrophilic or hydrophobic properties can be selected under the action of an external stress in a device for moving fluid as claimed in any one of the Claims 1 to 10.

26. A printing process using polymers whose hydrophilic or hydrophobic properties can be selected under the action of an external stress.

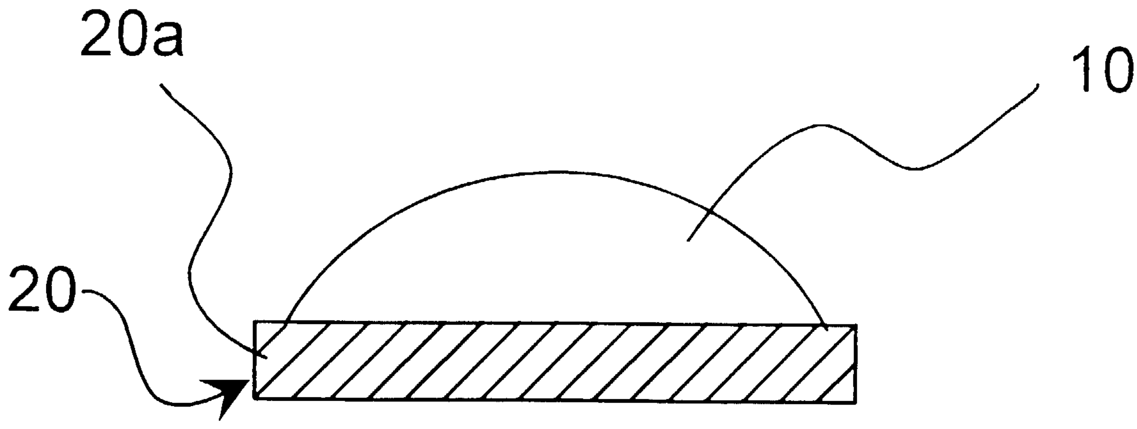

FIGURE 1A

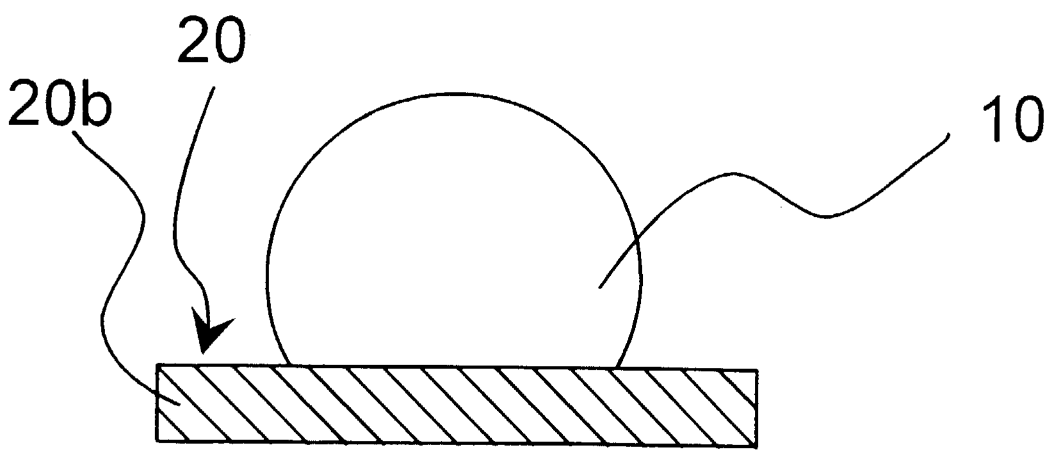

FIGURE 1B

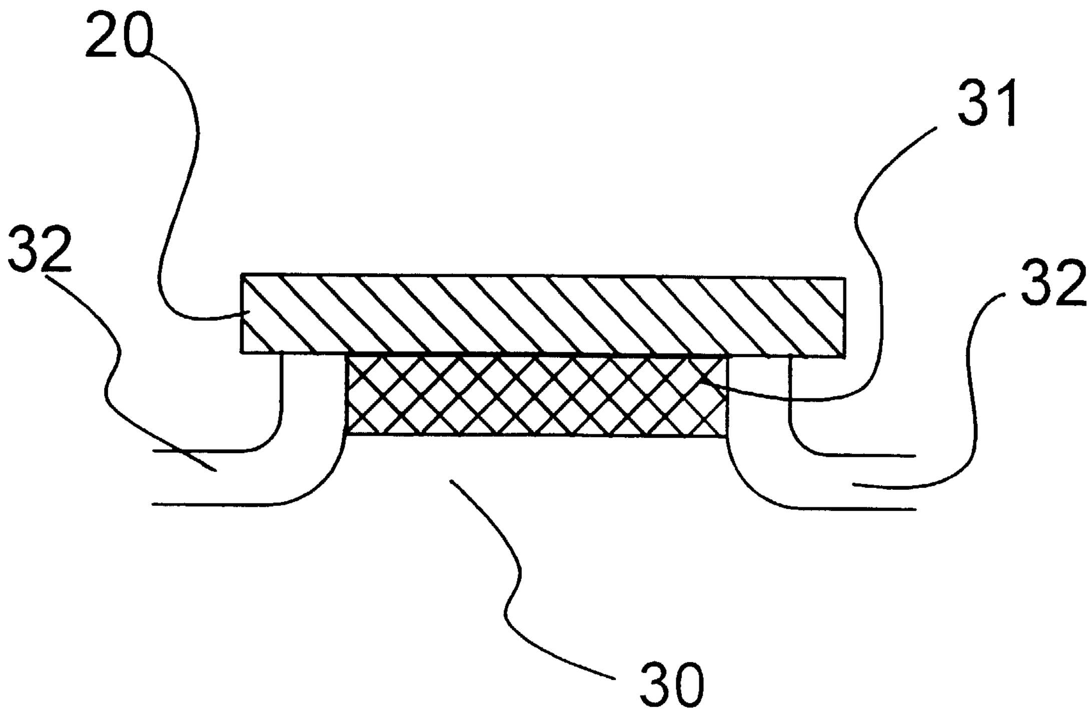

FIGURE 2

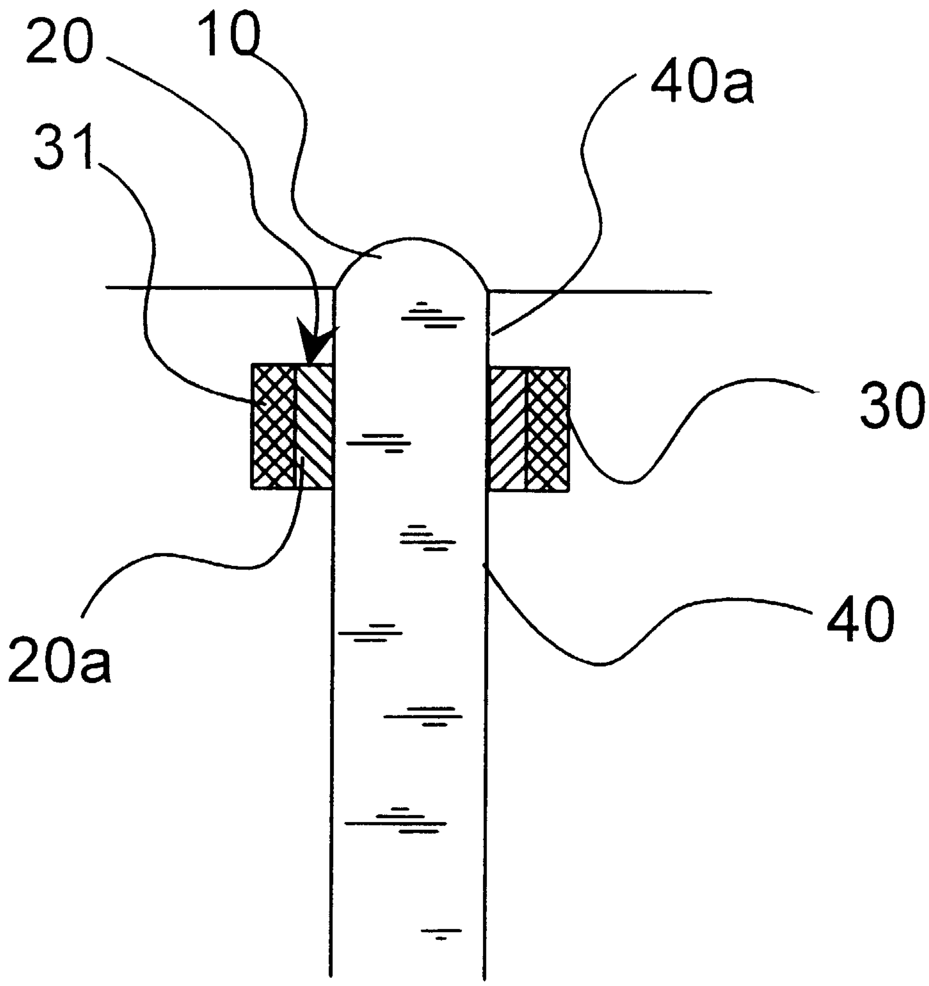

FIGURE 3

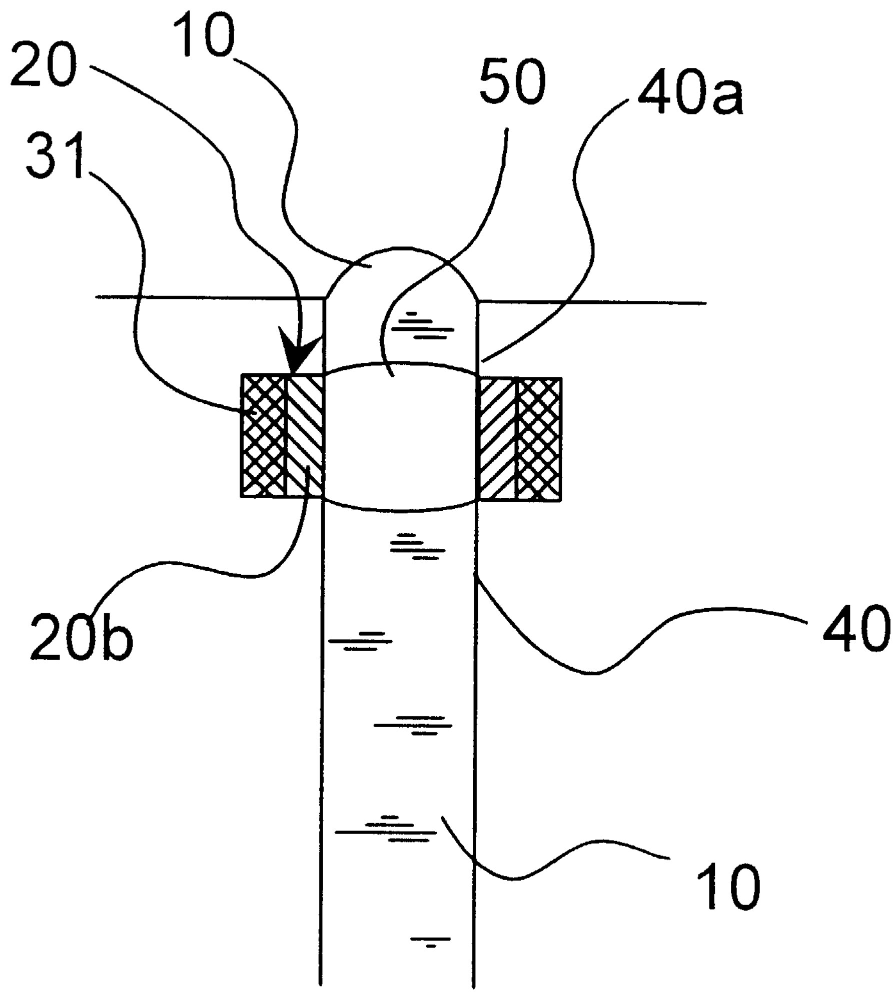

FIGURE 4

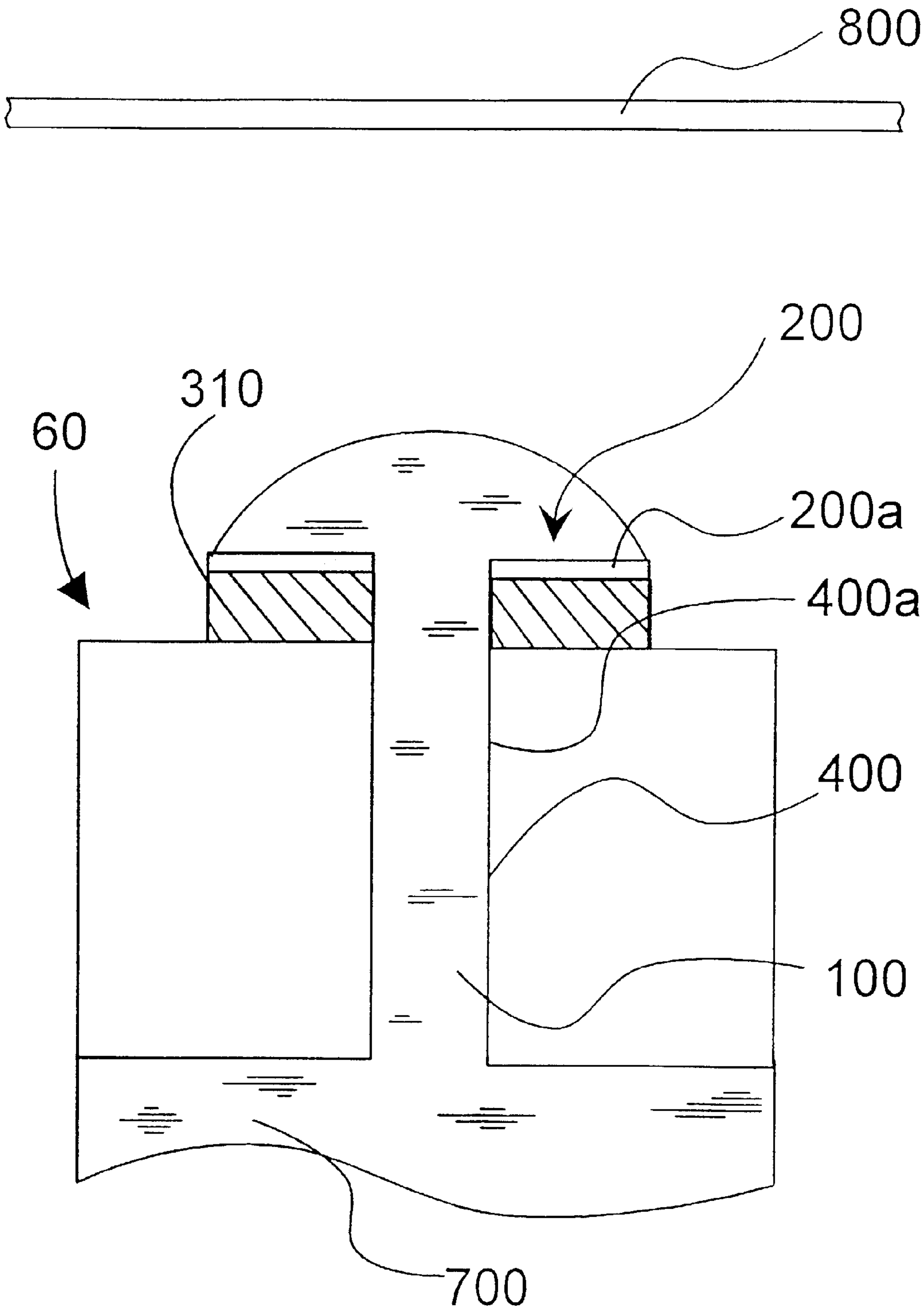

FIGURE 5A

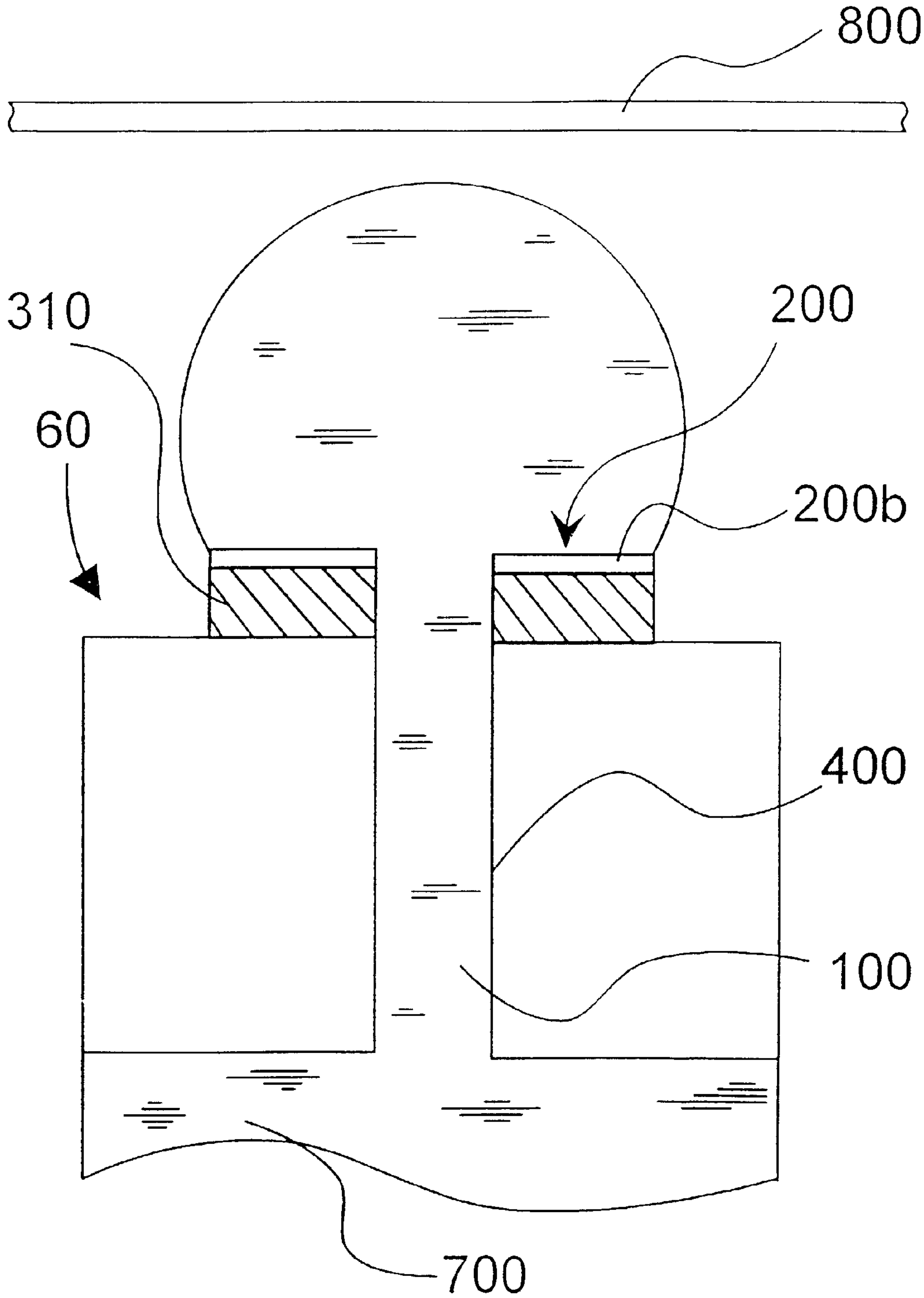

FIGURE 5B

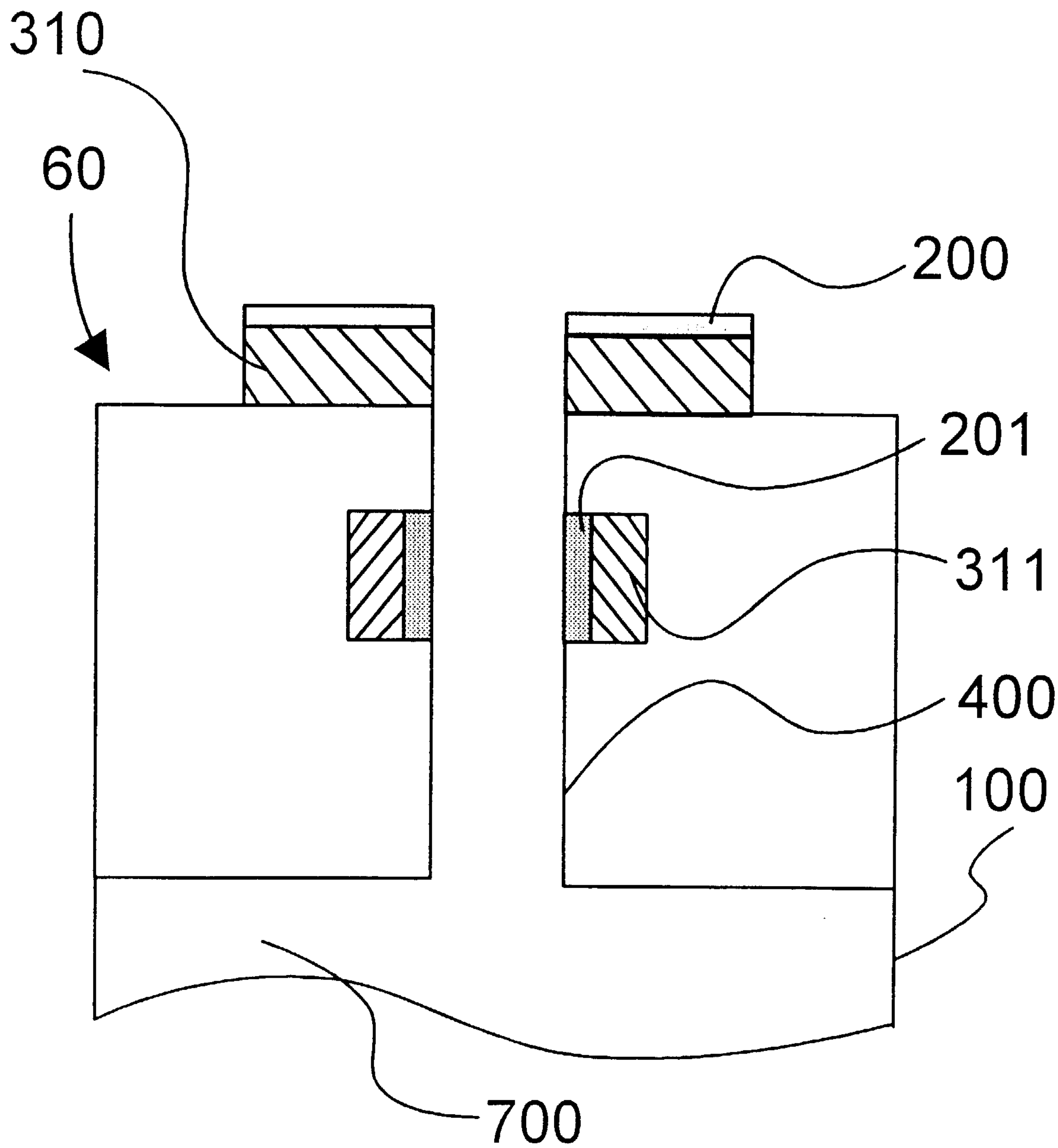

FIGURE 6

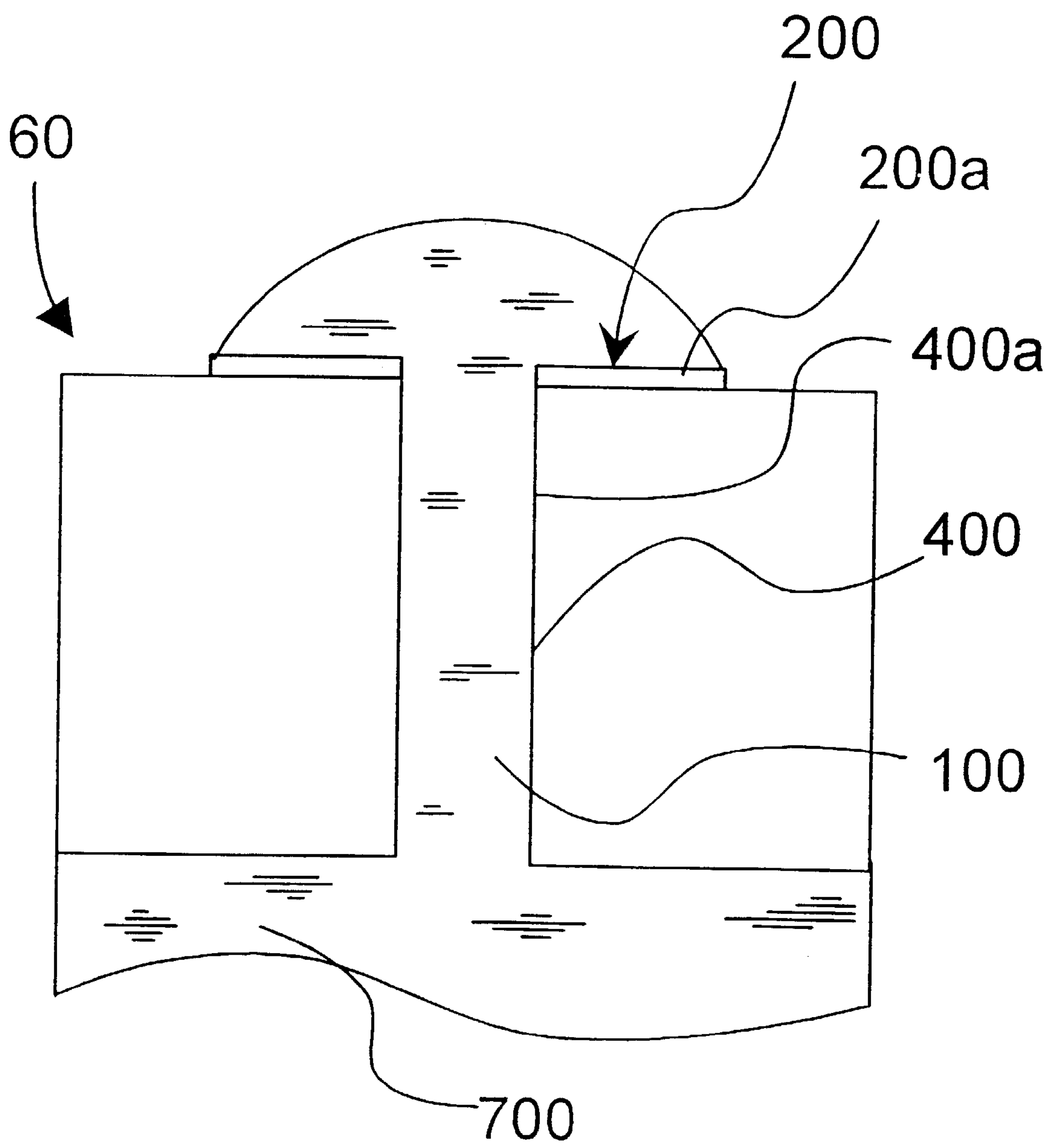

FIGURE 7

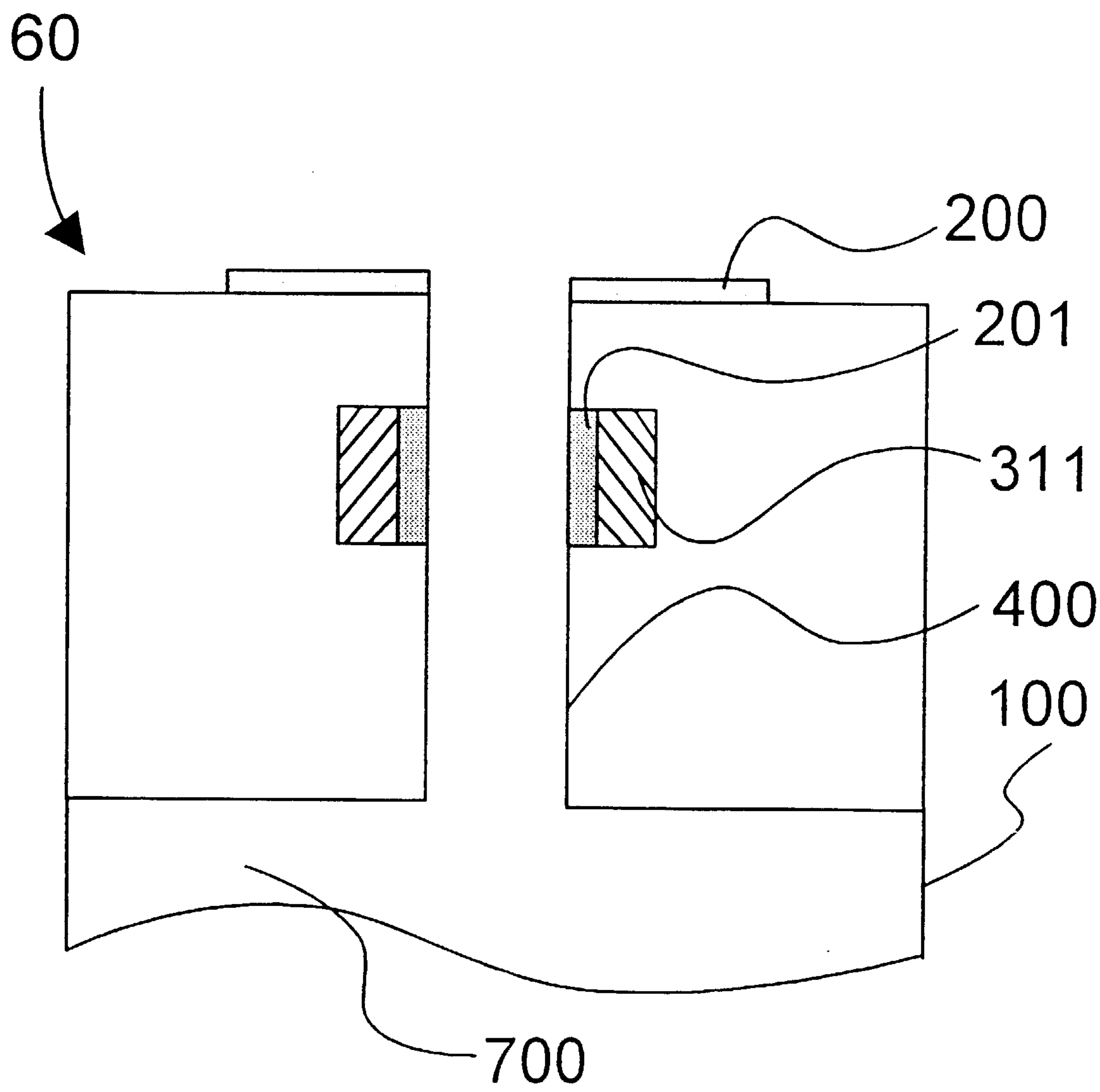

FIGURE 8

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EUROPEAN SEARCH REPORT

Application Number
EP 99 42 0052

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)
X	PATENT ABSTRACTS OF JAPAN vol. 016, no. 182 (P-1346), 30 April 1992 (1992-04-30) & JP 04 021844 A (MATSUSHITA ELECTRIC IND CO LTD), 24 January 1992 (1992-01-24) * abstract * ---	1,2,10, 25,26	B41J2/04 B41J2/005
X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 001, 31 January 1997 (1997-01-31) & JP 08 230232 A (MATSUSHITA ELECTRIC IND CO LTD), 10 September 1996 (1996-09-10) * abstract * ---	1,2,10, 25,26	
X	PATENT ABSTRACTS OF JAPAN vol. 096, no. 012, 26 December 1996 (1996-12-26) & JP 08 216368 A (HITACHI LTD), 27 August 1996 (1996-08-27) * abstract * ---	1,2,10, 25,26	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
X	US 5 278 126 A (KATANO ET AL) 11 January 1994 (1994-01-11) * the whole document * ---	1,2,10, 25,26	B41J
A	US 5 515 085 A (HOTOMI ET AL.) 7 May 1996 (1996-05-07) * the whole document * ---	1	
A	US 4 275 290 A (CIELO ET AL.) 23 June 1981 (1981-06-23) * the whole document * ---	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 July 1999	Meulemans, J-P

CATEGORY OF CITED DOCUMENTS

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A	PATENT ABSTRACTS OF JAPAN vol. 009, no. 260 (C-309), 17 October 1985 (1985-10-17) & JP 60 110709 A (KOGYO GIJUTSUIN;OTHERS: 0J), 17 June 1985 (1985-06-17) * abstract * ---	1	
A	US 4 166 277 A (CIELO ET AL.) 28 August 1979 (1979-08-28) * the whole document * ---	1	
A	US 4 396 925 A (KOHASHI) 2 August 1983 (1983-08-02) * the whole document * ---	1-26	
A	US 4 206 467 A (FUJII) 3 June 1980 (1980-06-03) * the whole document * ---	1-26	
A	EP 0 796 902 A (EASTMAN KODAK) 24 September 1997 (1997-09-24) * the whole document * -----	1	TECHNICAL FIELDS SEARCHED (Int.Cl.6)

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 99 42 0052

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08-07-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 04021844 A	24-01-1992	NONE	
JP 08230232 A	10-09-1996	NONE	
JP 08216368 A	27-08-1996	NONE	
US 5278126 A	11-01-1994	US 5471234 A	28-11-1995
		DE 4010275 A	04-10-1990
		JP 2796575 B	10-09-1998
		JP 3178478 A	02-08-1991
		JP 5031875 A	09-02-1993
US 5515085 A	07-05-1996	JP 5104737 A	27-04-1993
US 4275290 A	23-06-1981	NONE	
JP 60110709 A	17-06-1985	JP 1476632 C	27-01-1989
		JP 63032803 B	01-07-1988
US 4166277 A	28-08-1979	NONE	
US 4396925 A	02-08-1983	JP 1604278 C	22-04-1991
		JP 2026586 B	11-06-1990
		JP 57207068 A	18-12-1982
		JP 1601038 C	31-01-1991
		JP 2025336 B	01-06-1990
		JP 58007359 A	17-01-1983
		JP 1586231 C	31-10-1990
		JP 2011430 B	14-03-1990
		JP 57056266 A	03-04-1982
		JP 1689410 C	11-08-1992
		JP 3055316 B	22-08-1991
		JP 57056292 A	03-04-1982
		JP 1663226 C	19-05-1992
		JP 3026133 B	09-04-1991
		JP 57091279 A	07-06-1982
		EP 0048460 A	31-03-1982
US 4206467 A	03-06-1980	JP 1212558 C	12-06-1984
		JP 54004129 A	12-01-1979
		JP 58045352 B	08-10-1983
EP 796902 A	24-09-1997	JP 9263724 A	07-10-1997

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82