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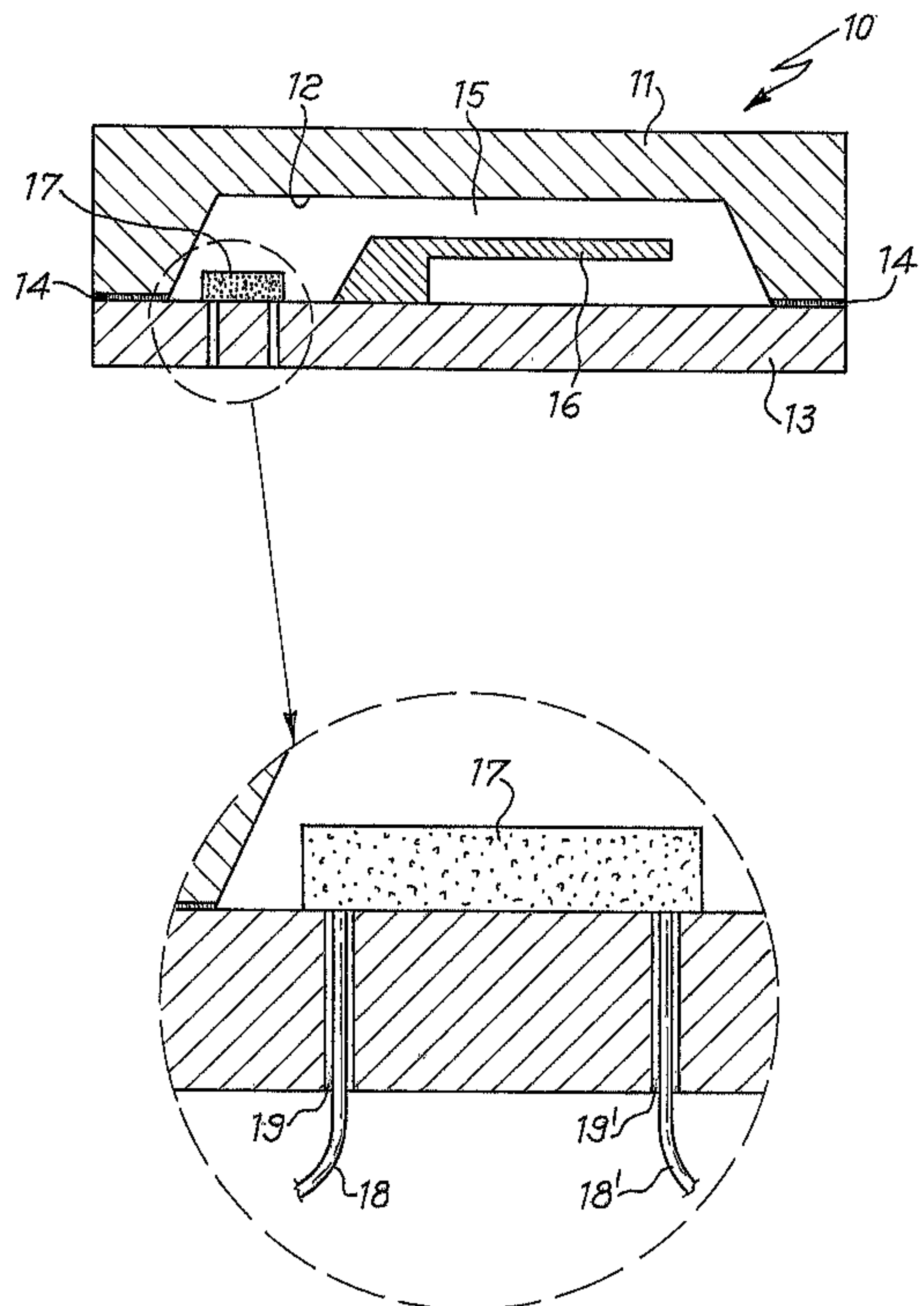
(54) Titre : DISPOSITIFS MICRO-MECANIQUES OU MICRO-OPTICO ELECTRONIQUES AVEC DEPOT DE MATERIAU DE DEGAZAGE, CHAUFFAGE INTEGRE, ET SUPPORT DE PRODUCTION ASSOCIE

(54) Title: MICROMECHANICAL OR MICROOPTOELECTRONIC DEVICES WITH DEPOSIT OF GETTER MATERIAL AND INTEGRATED HEATER, AND SUPPORT FOR THE PRODUCTION THEREOF



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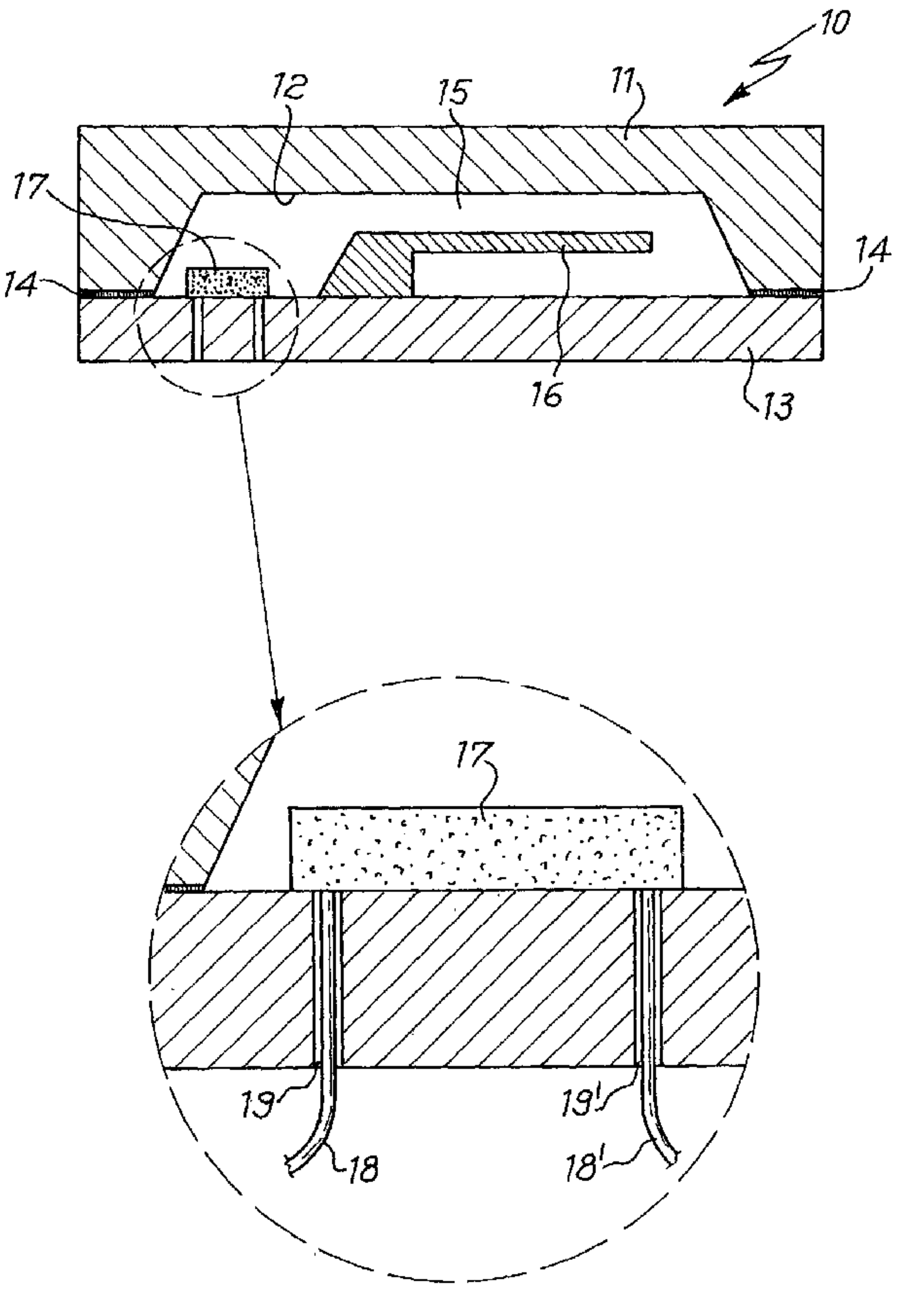

(57) Abstract: Micromechanical (10; 20) or microoptoelectronic (30) devices are described which comprises a deposit of getter material (17; 25; 35) for the sorption of gases being detrimental to the operation of said devices and an integrated system (18, 18', 19, 19') for heating the getter material from the outside at each moment this is required during the life of the device. Various embodiments of a support for manufacturing these devices are also described.

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MICROMECHANICAL OR MICROOPTOELECTRONIC DEVICES WITH DEPOSIT OF GETTER MATERIAL AND INTEGRATED HEATER, AND SUPPORT FOR THE PRODUCTION THEREOF

The present invention relates to micromechanical or microoptoelectronic devices comprising a deposit of getter material for the sorption of gases which are detrimental to the operation of said devices and an integrated heater for the activation or reactivation of the getter material during the life of the device itself; the invention also relates to supports particularly suited for the production of these devices.

Micromechanical devices (better known in the field with the definition "micromachines" or its abbreviation MMs) are under development for applications such as miniaturized sensors or actuators: typical examples of MMs are the microaccelerometers, used as sensors to activate automobile airbags, micromotors with gears and sprocket wheels having the size of a few microns, or the optic switches, wherein a mirror surface with a size of the order of some tens microns can be moved between two different positions, directing a light beam along two different directions, one of which corresponding to the "on" condition and the other to the "off" condition of an optical circuit.

The microoptoelectronic devices comprise, for example, new generation infrared radiation (IR) sensors which, unlike the traditional ones, do not require cryogenic temperatures for their operation. These IR sensors are formed of an array of semiconductor material deposits, for example silicon, arranged in an evacuated chamber. All these devices will be referred to in the following by the general definition of miniaturized devices.

The miniaturized devices are generally manufactured through a technology derived from the microelectronic industry, comprising operations of depositing on a planar support layers of materials with different electric (or magnetic) functionality, alternated to selective removals thereof. These devices are generally contained in housings formed, in their turn, with the same techniques. The support which is most commonly used in these productions is a silicon wafer, less than about 1 mm thick and with a diameter of up to 30 cm. On each one of these wafers a very high number of devices are manufactured; then, at the end of the manufacturing process, from these wafers by mechanical or laser cut are separated the single devices in the case of MMs, or parts including an array of some tens of devices in the case of IR sensors.

The steps of depositing the various layers are carried out with such techniques as Chemical Vapour Deposition, generally referred to as "CVD", or Physical Vapour Deposition (or "PVD"). the latter being commonly indicated also as "sputtering". Generally, selective removals are carried out through chemical or physical etchings with suitable masking, as it is well known in this field.

Generally MMs are then incapsulated in metallic or ceramic containers, essentially for mechanical protection reasons, before being inserted in the final destination apparatus (a computer, an automobile, etc.). IR radiation sensors are instead generally comprised in a chamber, facing one wall thereof, called "window", transparent to the IR radiation.

The functionality of the miniaturized devices can be altered by the presence of undesired gases. In MMs, the mechanical friction between gas molecules and a moving part, due to the very small size of the latter, can lead to sensible deviations from the device's ideal operation; moreover, polar molecules such as water can cause phenomena of adhesion between the moving part and other parts, for example the support thereof, thus causing the possible device failure. In case of IR sensors, the gases possibly present in the chamber can sorb a fraction of the radiation or transport heat by convection from the window to the array of silicon deposits, thus modifying the measurement. Therefore it is fundamental to ensure that the housing of these miniaturized devices is kept under vacuum during the whole life of the device.

In order to minimize the gas amount in these devices, their manufacturing is usually carried out in vacuum chambers while resorting to pumping steps before the packaging thereof. However the problem is not completely solved in this way, because the same materials the devices are made of can release gases, or these can permeate from the outside (e.g. through the weldings).

To remove also the gases entering the solid state devices during their life, it has been proposed the use of a getter material. Getter materials are metals such as zirconium, titanium, vanadium, niobium or tantalum, or alloys thereof with other transition metals, Rare Earths or aluminum. These metals or alloys have a strong chemical affinity with gases such as hydrogen, oxygen, water, carbon oxides and, in some extent, lower hydrocarbons; some getter alloys are also capable of sorbing nitrogen. The use of getter materials in MMs is disclosed e.g. in the article "Vacuum packaging for microsensors by glass-silicon anodic bonding" by H. Henmi et al., published on the technical magazine Sensors and Actuators A, vol. 43 (1994), at pages 243-248, and in the patents US 5,155,778, US 5,952,572 and US 6,469,821, while the use of getter materials in IR sensors is disclosed e.g. in the patents US 5,921,461 and US 6,252,229.

International patent applications WO 03/009317 and WO 03/009318 in the applicant's name, and patent application US 2003/0138656 describe wafers to be used in manufacturing miniaturized devices, wherein on the wafer there is already a layer of a gas sorbing material, possibly temporarily protected and to be exposed to the internal atmosphere of the device during its manufacturing.

As it is known, getter materials (both metals and alloys) require for their operation a thermal treatment of initial activation, by which a passivating layer (generally formed of oxides, carbides or nitrides of the metals) is removed from the material surface and a fresh "clean" surface is exposed, capable of interacting with gases. In the known processes for manufacturing miniaturized devices containing getter materials, this activation is carried out during the thermal treatment of sealing, wherein two parts (generally of silicon) are welded to each other by heating at about 1000°C in case of direct welding silicon-silicon, or at a lower temperature in case that a suitable material is interposed between the two parts, such as an eutectic Au-Si composition melting at about 370°C.

However, during this process, the materials forming the miniaturized device can release gases which are sorbed by the getter. The consequence is an inefficient getter activation, since the material is continuously exposed to the gases during the whole high temperature treatment, so that at the end of the process its surface will not be formed of metallic atoms only, but it will be still covered with oxides, carbides of nitrides, to a so greater extent as greater is the quantity of gases in the environment of the getter during the thermal treatment. In the worst case (high gas loads), upon sealing the device the getter is practically inactive. The cited patent application US 2003/0138656 describe a wafer in which the getter layer is temporarily protected by a very thin layer of an inert metal, e.g. gold, that during the welding step at high temperature diffuses into the getter, thus liberating a fresh surface of getter material; however, in this case there is no control on the time frame or the degree of this diffusion, that may thus happen too early (thus not avoiding in practice the problem of having a spent getter at the end of the process) or to a too limited extent, so that there is in the end only a limited amount of free getter, with a resulting low gas-sorption activity.

Therefore it would be necessary to have the possibility of subjecting the getter to a treatment of reactivation or to keep it at a temperature of about 300°C during the working steps of the miniaturized device. However this requires heating of the whole device, which is generally impractical and in some cases impossible to be performed, as at the getter activation temperatures there is the risk of damaging the device.

To solve this problem, the patent application US 2002/0149096 proposes a method for manufacturing miniaturized devices operating under vacuum wherein the getter can be heated at will during the life of the device. According to the teaching of this application, on the substrate of the device provided with the active (mechanical or optoelectronic) structures also a getter material deposit is formed, that can be activated when necessary by means of a transistor which is also integrated in the substrate.

This method, although overcomes the drawbacks of the passive activation in the welding step and of an active one by heating the whole device, involves however a rather complex structure of the device. In fact, the activation transistor (or other similar semiconductor device) is formed first on the substrate, possibly as overlapping of various layers, then covered with a layer of dielectric material, this too possibly as overlapping of various layers, wherein openings connecting to the underlying transistor must be formed. On the dielectric material a layer of electrically conductive material is then applied, which is connected to the transistor through the above-mentioned openings and in turn leads the activation current to the overlying layer of getter material directly or through an additional layer of electrically resistive material acting as heater.

It is clear that such a structure gives rise to manufacturing times and costs which are rather high, as well as possible inconveniences of operation during the getter activation steps. The dielectric layer is in fact necessary to protect the transistor or other semiconductor whose performances are spoiled by temperatures of about 400°C, that can be reached for the getter activation. Furthermore it is also provided the presence of a temperature sensor which is able to send a signal to disactivate the getter heating system when a pre-fixed threshold is exceeded. This obviously implies a further increase of costs and complexity of the device.

As regards the process, the use of the same manufacturing tools both for the transistors and for the getter material can result in contamination by zirconium or other heavy metals comprised in the getter film, which can change the features of electric conductivity of other semiconductor layers of different transistors.

Finally it should be considered that to make such a structure it is impossible to use the wafers with previously applied getter material according to the above-mentioned international applications, whereby a specific manufacturing step is always required for the application of the getter material.

The object of the present invention is to overcome the above-mentioned drawbacks of the prior art devices, by providing micromechanical or microoptoelectronic devices having simple structure in which it is possible to heat the getter material only at any moment of the device life.

This object is achieved by means of devices comprising a deposit of getter material and integrated members for heating the getter material in the form of electric contacts passing throughout the device structure and connected to the getter material directly or through a heater, possibly provided with a layer of dielectric material. Other advantageous features are indicated in the dependent claims.

The basic advantage of the device according to the present invention lies in fact in the possibility of activating at will the getter during the device life, while maintaining a simple structure of economic manufacture, which can be advantageously made from semi-finished elements.

This and additional advantages and features of the device according to the invention will become apparent to those skilled in the art from the following detailed description of some embodiments with reference to the annexed drawings in which:

- Fig. 1 shows in cross-section a first embodiment of a miniaturized device according to the invention, representing the case of a MM;
- Fig. 1a shows an enlarged view of the region of the device of Fig. 1 where the getter material is present;
- Fig. 2 shows in cross-section a second embodiment of MM according to the invention;
- Fig. 3 shows in cross-section a third embodiment of the miniaturized device according to the invention, in the case of a miniaturized IR sensor;
- Fig. 4 shows in cross-section a variation that can be applied to the above embodiments of the invention;
- Figs. 5-7 show in cross-section some embodiments of supports for the manufacturing of miniaturized devices according to the invention.

Making reference first to Figs. 1 and 1a, a MM is represented, comprising a getter material and the integrated heater member for the getter material. MM 10 comprises a first portion 11 (cap) in which a hollow 12 is formed, and a second portion 13 (base), welded to each other along the perimeter 14 thus defining an inner space 15. In this space the mobile portion of MM is housed, being schematically represented in the drawing as member 16; for the sake of clarity there are not shown the electrical contacts for feeding the mobile member 16 or for transmitting outside a signal detected by member 16 when the MM is a sensor (for example a microaccelerometer). In the space 15 there is also present a deposit 17 of getter material for removing therefrom gas molecules which would interfere with the correct operation of the MM.

As shown in Fig. 1a, at two opposite ends of deposit 17 two electrical contacts 18, 18' are connected by throughholes 19, 19' formed in the base 13. Holes 19, 19' and deposit 17 must be so constructed as to ensure gas-tightness of the structure. To this effect holes 19, 19' can be filled with metal, and the metal in the holes 19, 19' emerging at the external surface of base 13 can then be used to form electrical connections, such as with cables (whose ends can e.g. be embedded in the metal) or, according to a more usual solution in the electronic field, with conductive "tracks" formed in turn on said external surface of base 13 (such as by screen printing).

Fig. 2 shows in cross-section an alternative embodiment of a MM according to the invention. In this case MM 20 is formed of a base 21 and a cap 22 welded together along their perimeter, thus defining a space 23; in space 23, on the inner surface of base 21, there is formed the mobile portion 24 of the MM (also in this case the electric contacts to connect this portion to the outside are not shown).

Differently from the device represented in Fig. 1, in this case a deposit 25 of getter material is formed on the inner surface of cap 22. The deposit 25 is connected through two holes 26, 26', formed in cap 22, to two electric contacts 27, 27' for its heating by current flow. Also in this case recourse can be made to the filling of holes 26, 26' with a metal to ensure gas-tightness of space 23. A structure of type 20 can result preferable, as the forming of deposit 25 on a surface free of other structures make easier all the manufacturing steps and also the surface available for deposit 25 is increased as well as its efficiency in gas removal.

Fig. 3 shows schematically the use of the invention in case of a microoptoelectronic device, in the exemplified case an IR microsensor. Microsensor 30 is formed of a base 31 and a cap 32 which define an inner space 33 to be kept under vacuum and from which possible gas traces must be removed by the getter material. Cap 32 is transparent to IR radiation, symbolically represented by wavy arrows. On the inner portion of base 31 members 34, 34', ... are formed, which are responsive to IR radiation; also in this case the circuitry useful to connect these members to the outside is not shown. In a portion of the inner surface of base 31 which is free from sensor members there is formed a deposit 35 of getter material, also in this case connected to electric contacts 36, 36' by means of holes formed in base 31 (the holes are not shown for the sake of drawing clarity).

In case of a microoptoelectronic device it is impossible to adopt the configuration of Fig. 2 in order not to affect the features of transparency to IR radiation of cap 32. It is possible anyway to place getter material along a perimetral frame of cap 32 or along the vertical walls of base 31 to leave the whole horizontal surface of base 31 available for the sensor members 34, 34'... .

In all the above-illustrated devices, when the characteristics of the deposit of getter material are such that it cannot be efficiently heated by a flow of electric current, it is possible to adopt the variation of the invention as represented in Fig. 4, which shows in cross-section only essential elements of the variation itself.

In this case the getter material deposit 40 is not directly formed on base 41 (which can be anyone of elements 11, 13, 21, 22, 31 or 32), but on an additional layer 42 having electric features which are suitable to heating by current flow. Layer 42 is connected to contacts 43, 43' which, by means of throughholes 44, 44', are in turn in contact with external electric connections as described with reference to Fig. 1.

In an additional variation, not shown, if the getter material used cannot be in direct contact with the heating layer 42 for chemical and/or physical reasons, an additional layer can be provided which is electrically insulating but thermally conductive (e.g. silicon dioxide) interposed between getter and heater 42.

Getter materials which is possible to use in the invention are the most varied and comprise metals such as Zr, Ti, Nb, Ta, V, alloys among these metals, or alloys among these and one or more elements chosen among Cr, Mn, Fe, Co, Ni, Al, Y, La and Rare Earths. As examples mention can be made of binary alloys Ti-V, Zr-V, Zr-Fe and Zr-Ni, ternary alloys Zr-Mn-Fe, Zr-V-Fe or Zr-Co-A (wherein A represents mischmetal, a commercial mixture of yttrium, lanthanum and Rare Earths), or mixtures among the previously indicated metals and alloys; these mixtures are preferable due to their good mechanical features, with particular regard to the loss of particles.

The deposit of getter material can be obtained with various techniques, such as cold rolling, which is possible if the support on which the deposit is formed is not too fragile; electrophoresis, being possible in case the support is an electrical conductor, and possibly confining the deposit through suitable maskings with insulating materials to be removed after the deposit formation; screen printing, by confining the deposit with mechanical maskings; or the sputtering technique, also in this case by confining the deposit in the desired area by means of chemical maskings to be removed after deposition. For miniaturized devices of lateral sizes of some millimetres, it is possible to use all the indicated techniques, whereas for devices having lateral sizes of about 1 mm or less, the preferred technique is sputtering.

For the invention purposes the getter deposit must be able to be heated by current flow at a temperature between about 200 and 400°C, preferably between about 250 and 350°C. The more compact deposits, such as those obtained by sputtering, can be directly heated at the desired temperatures by current flow.

On the contrary, more porous deposits such as those obtained by electrophoresis or screen printing may be difficult to heat directly by current flow and in this case it is preferable to make use of the getter material being deposited on an additional layer of suitable characteristics as shown in Fig.4. In this case the additional layer 42 can be made of metal, such as aluminum, or a semiconductor material, such as polycrystalline silicon. Metallic deposits can be obtained with suitable maskings by means of techniques such as screen printing, evaporation, galvanic technique or sputtering, all widely known in the field of metallic layer formation.

The member on which the getter material deposit is formed can be made, depending on the miniaturized device, in various materials, such as metals, ceramics, semiconductors or glass. The preferred material is silicon, as it allows to apply in the field of micromechanical or microoptoelectronic devices the common techniques, now well-established in the field of microelectronic, consisting in the formation of thin layers on a support and a partial, local removal of these layers, thus obtaining structures of extremely small size in a precise and reproducible manner.

In case of silicon being used, also the throughholes (19, 19'; 26, 26'; 44, 44') leading the electric supply to the deposit of getter material or the layer 42 can be obtained by a technique which is typical in the field of microelectronic, i.e. the anisotropic etching with solutions generally containing the fluoride ion. The speed at which silicon dissolves in these solutions is very different in the various lattice directions of a single crystal of the element, so that the etching proceeds almost exclusively along the direction of maximum dissolution speed. Use is made of this characteristic to produce holes of precise size and direction, by cutting a slice of silicon along a plane suitably oriented with respect to the crystal axes, masking the slice with a protective substance in the areas in which etching is to be avoided, and causing thus the directional etching to occur only in pre-selected regions.

In a second aspect thereof the invention deals with the supports for manufacturing micromechanical or microoptoelectronic devices with an integrated deposit of getter material and members for heating the same.

A support according to the invention may be made of metal, ceramic, glass or of a semiconductor material; due to the importance of this latter choice, in the following reference will be made to semiconductor supports. Said support is preferably a wafer of silicon, similar to the supports described in the international patent applications WO 03/009317 and WO 03/009318, but on which there are already provided, in correspondence with the getter material deposit, the throughholes and the electric contacts and possibly a layer of a material that can be heated by flow of electric current in contact with the getter material. As described in the cited applications, the getter material deposit can be temporarily protected and become exposed during the manufacturing of the miniaturized device.

Fig. 5 shows in a sectional view a portion of a possible support according to the invention (the dimensional ratios of the various parts, in particular the thickness, are not in scale). Support 50 is formed of a base 51, e.g. of silicon, on which there is deposited a continuous layer 52 of a getter material. On surface 53 of base 51 a number of holes 54, 54' in pairs are formed, which allow to bring electrical connections into contact with layer 52. Since in this case layer 52 is continuous, this support can be applied in the configuration previously illustrated with reference to Fig. 2, wherein the getter material is present on a MM portion opposite to that of mobile portion 24. A number of MMs can be formed from support 50 by cutting the same along the broken lines as shown on surface 53.

A second possible support is represented in cross-section in Fig. 6. In this case the support 60 is formed of a number of layers of different materials which are in the order: a base 61, e.g. of silicon; a layer 62 of a material that can be easily heated by current flow (e.g., aluminum); a layer 63 of getter material; and a layer 64, for example in silicon oxide, for the temporary protection of layer 63 from the atmospheric gases. In base 61 pairs of holes 65, 65' are formed, which allow the electric supply of layer 62 for its heating. The broken lines are those along which the support 60 will be cut for producing a plurality of MMs; during the manufacturing the layer 64 will be also removed totally or partially, thus allowing the getter material to be exposed to the inner atmosphere of the MM.

In other variations of the support of the invention, the two layers 62 and 64 could not be present together; for example, in the case that the layer of getter material has already features suitable to heating by current flow, the presence of layer 62 can be avoided, or it is possible to have a support with layer 62 but without the protective layer 64.

Finally, a last embodiment of support according to the invention is shown in cross-section in Fig. 7. In this case support 70 consists of a base 71 on which a number of local deposits 72, 72', 72", ... of getter material is present; a pair of holes 73, 73' being formed in base 71 is associated with each one of these deposits, for electrically connecting the deposit with the outside. Regions 74, 74', 74", ... of base 71 are kept free for the construction of the active structures of the miniaturized device and the broken lines again indicate the cutting lines of support 70 for the production of a number of miniaturized devices.

Also in this case the measures described with reference to Fig. 6 can be adopted, and namely employing a resistive layer between base 71 and deposits 72, 72', 72", ... to improve the heating of these latter deposits; or employing a layer thereon for the temporary protection of the deposits from atmosphere. A support of type 70 can be employed in manufacturing MMs, but its use is especially preferable in case of microoptoelectronic devices wherein, as mentioned above, the housing portion opposite to that on which the active structures are obtained must be transparent to radiation and thereby cannot house the deposit of getter material over its own whole surface.

It is clear that the embodiments of the device according to the invention as described and illustrated above are only examples susceptibles of many variations. In particular the precise shape and placement of the mobile or sensor members and of the getter material deposits can freely vary according to the needs, as well as the material employed and the shapes of the housing hollows, which can be formed either on the base or on the cap or partly on both portions.

Another advantage offered by the invention in case the getter deposit is heated directly through passage of electric current (that is, in case no additional layer of kind 42 is present) is that, by means of the same electric contacts (e.g., 18, 18' or 27, 27') it is possible to monitor the residual gas sorption capability of the getter material. The electric resistance of deposits of getter materials is known to increase with the amount of oxide, nitride or carbide species formed at the surface of the material; thus, by checking from time to time the value of electric resistance of the getter deposit using the same contacts as probes, and comparing this value with a preset value indicating exhaustion of the getter, it is possible to know when the getter deposit needs reactivation and thus submitting the deposit to a reactivation step only when needed.

Possible additions and/or modifications can thereby be made to the device object of the present invention without departing from the protective scope of the invention.

CLAIMS

1. A micromechanical (10; 20) or microoptoelectronic (30) device comprising a deposit of getter material (17; 25; 35) and integrated members for heating the getter material, said members being connected to said deposit (17; 25; 35) and to the outside of the device, characterized in that said integrated members consist of two electric contacts connected to two opposite ends of the deposit (17; 25; 35) of getter material and, by means of throughholes formed in the device body, electrically connected to the outside of the device; the assembly formed of said electric contacts, throughholes, and getter material deposit being gas-tight.

2. A device according to claim 1, characterized in that said throughholes are filled with metal.

3. A device according to claim 1, characterized in that said integrated members for heating the getter material comprise also an additional layer (42) of a material which can be heated by electric current flow, said additional layer (42) being interposed between the electric contacts and the getter material.

4. A device according to claim 3, characterized in that said additional layer (42) is made of metal or a semiconductor material.

5. A device according to claim 4, characterized in that said additional layer (42) is made of aluminum or polycrystalline silicon.

6. A device according to claim 3, characterized in that said integrated members for heating the getter material also comprise a layer of electrically insulating but thermally conductive material interposed between the additional layer (42) and the getter material deposit.

7. A device according to claim 6, characterized in that said insulating layer is made of silicon dioxide.

8. A device according to claim 1, characterized in that said deposit of getter material is formed with one or more metals selected among zirconium, titanium, niobium, tantalum, vanadium, alloys among these metals, or among these metals and one or more other elements chosen among chromium, manganese, iron, cobalt, nickel, aluminum, yttrium, lanthanum and Rare Earths.

9. A device according to claim 8, wherein said getter material is an alloy chosen among the binary alloys Ti-V, Zr-V, Zr-Fe and Zr-Ni, the ternary alloys Zr-Mn-Fe, Zr-V-Fe or Zr-Co-A, wherein A represents a mixture of yttrium, lanthanum and Rare Earths.

10. A device according to claim 1, wherein said getter material is a mixture between a metallic element selected among zirconium, titanium, niobium, tantalum, vanadium and an alloy among these metals or among these metals and one or more other elements chosen among chromium, manganese, iron, cobalt, nickel, aluminum, yttrium, lanthanum and Rare Earths.

11. A micromechanical device (10) according to claim 1, characterized by the fact of being comprised of a cap (11) wherein a hollow (12) is formed and of a base (13) on which a mobile member (16) is fixed, on the base there being also formed the deposit (17) of getter material, the throughholes (19, 19') and the electric contacts (18, 18').

12. A micromechanical device (20) according to claim 1, characterized by the fact of being comprised of a cap (22) in which a hollow is formed and of a base (21) on which there is fixed a mobile member (24), with the deposit (25) of getter material, the throughholes (26, 26') and the electric contacts (27, 27') being formed on said cap (22).

13. A microoptoelectronic device (30) according to claim 1, characterized by the fact of being comprised of a cap (32) transparent to the electromagnetic radiation and of a base (31) wherein a hollow is formed in which there are placed members (34, 34'...) responsive to electromagnetic radiation and a deposit of getter material (35), with the electric contacts (36, 36') and throughholes being formed on said base (31).

14. A support (50; 70) for manufacturing devices according to claim 1, characterized by comprising a base (51; 71) on which there are at least a deposit of getter material (52; 72, 72', 72") and at least a pair of throughholes (54, 54'; 73, 73') giving access to two different points of the side of said deposit of getter material facing said base (51; 71).

15. A support (60) for manufacturing devices according to claim 3,

characterized by comprising a base (61), a layer (62) of a material heatable by current flow overlapping said base (61), a deposit of getter material (63) overlying said layer (62) of heatable material, and at least a pair of throughholes (65, 65') giving access to two different points of the side of said layer (62) of heatable material facing said base (61).

16. A support according to one of claims 14 or 15, characterized by further comprising a layer (64) overlying the deposit of getter material for the temporary protection of said deposit of getter material.

Fig.1

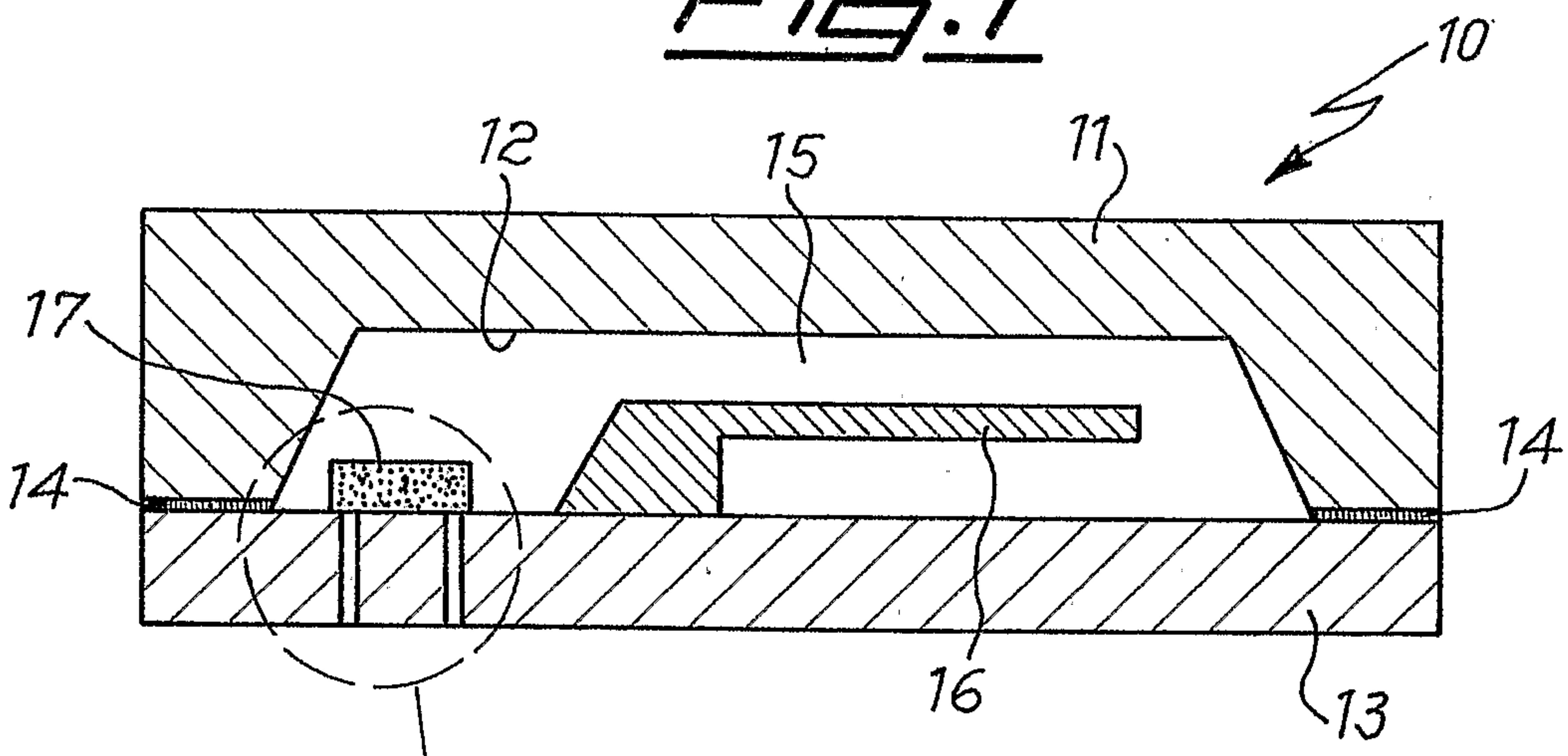


Fig.1a

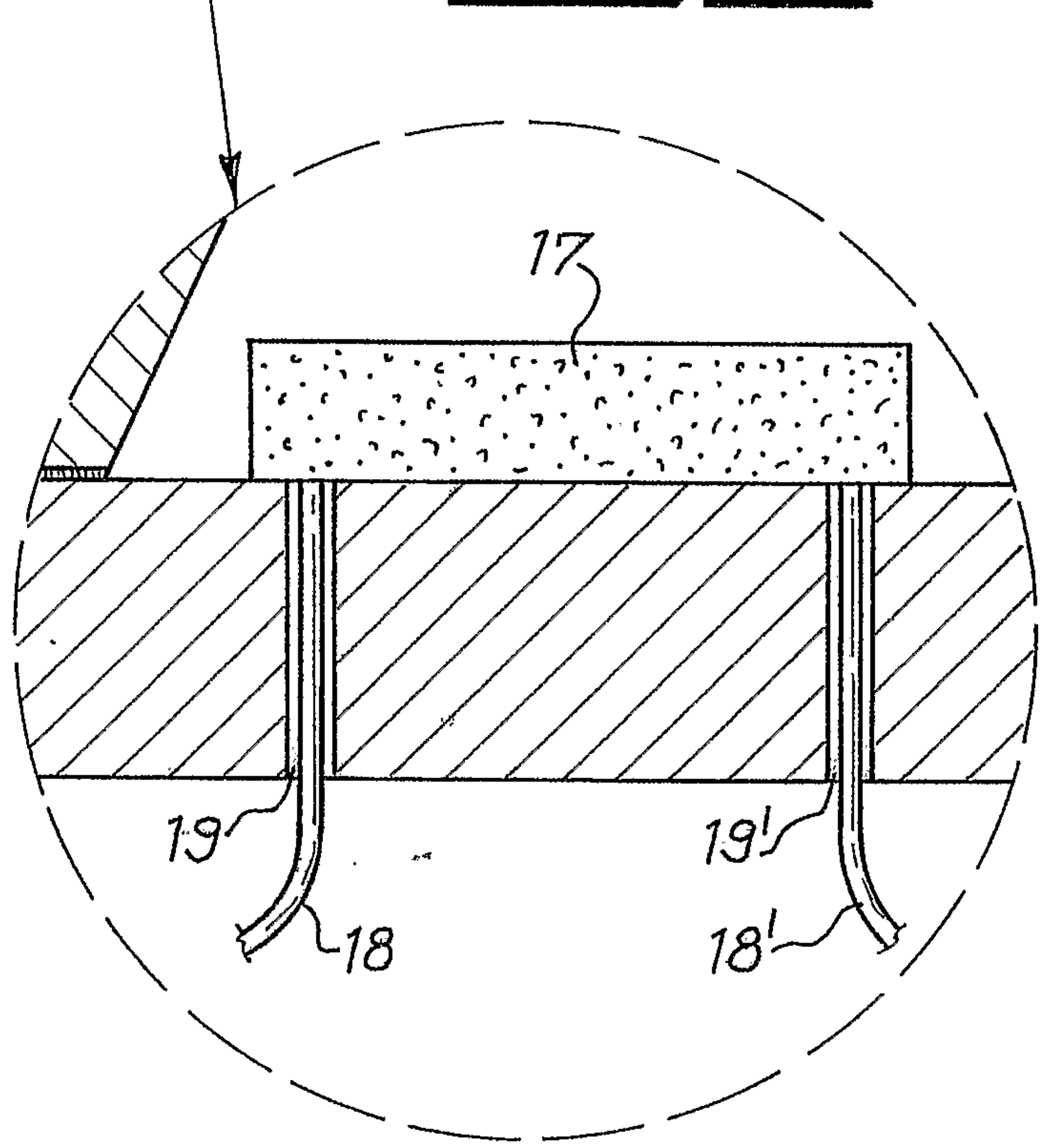


Fig. 2

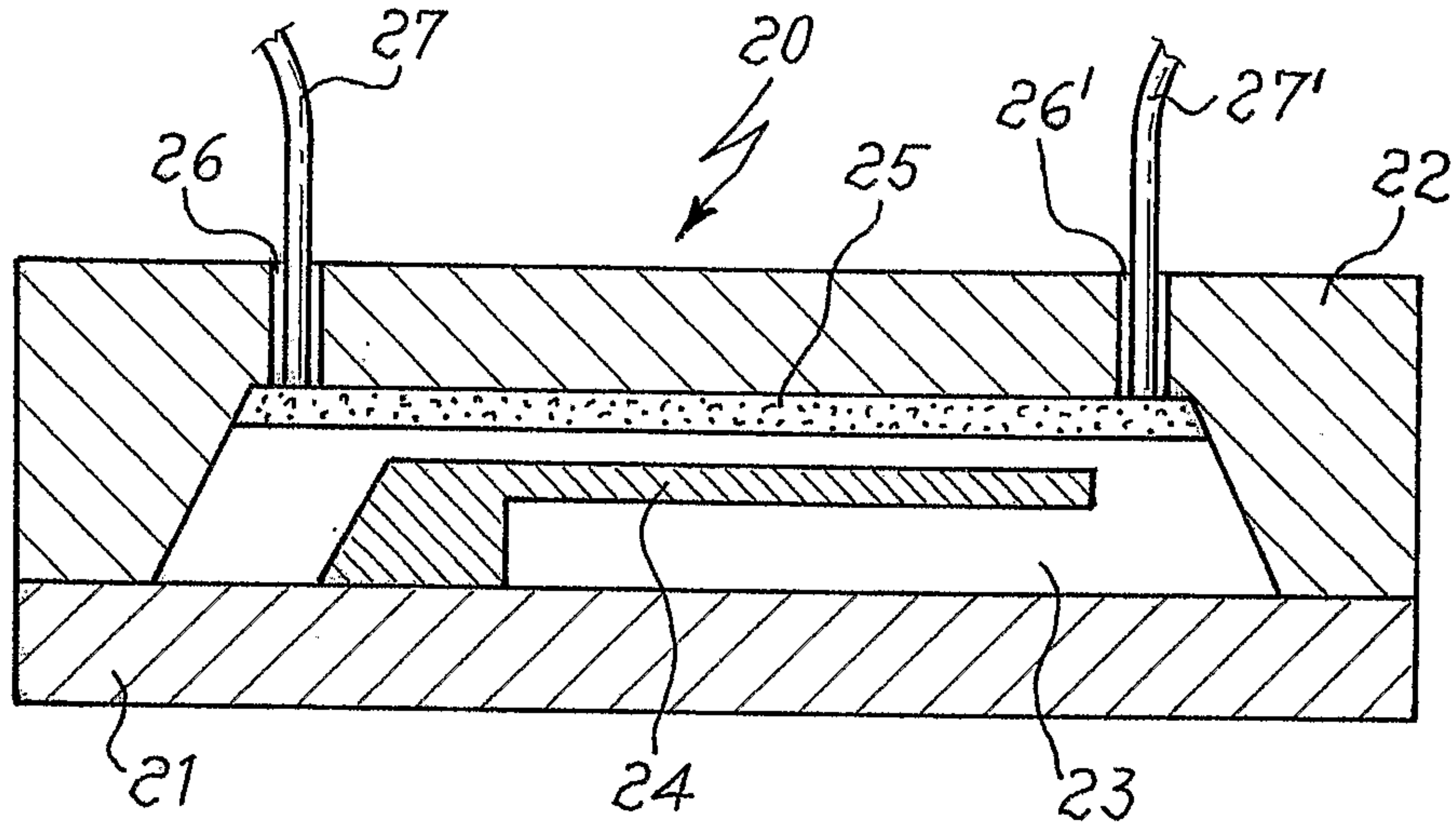


Fig. 3

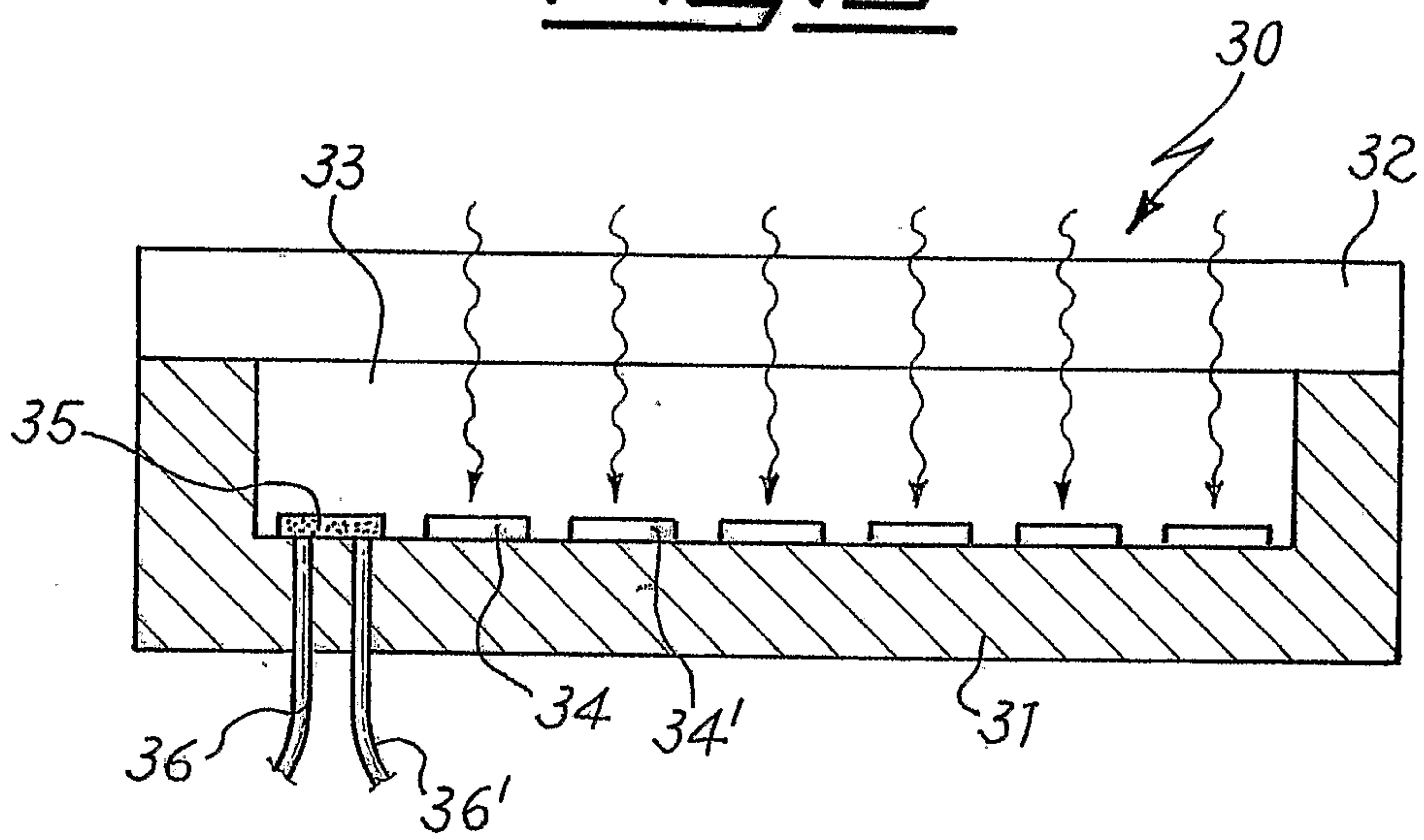


Fig.4

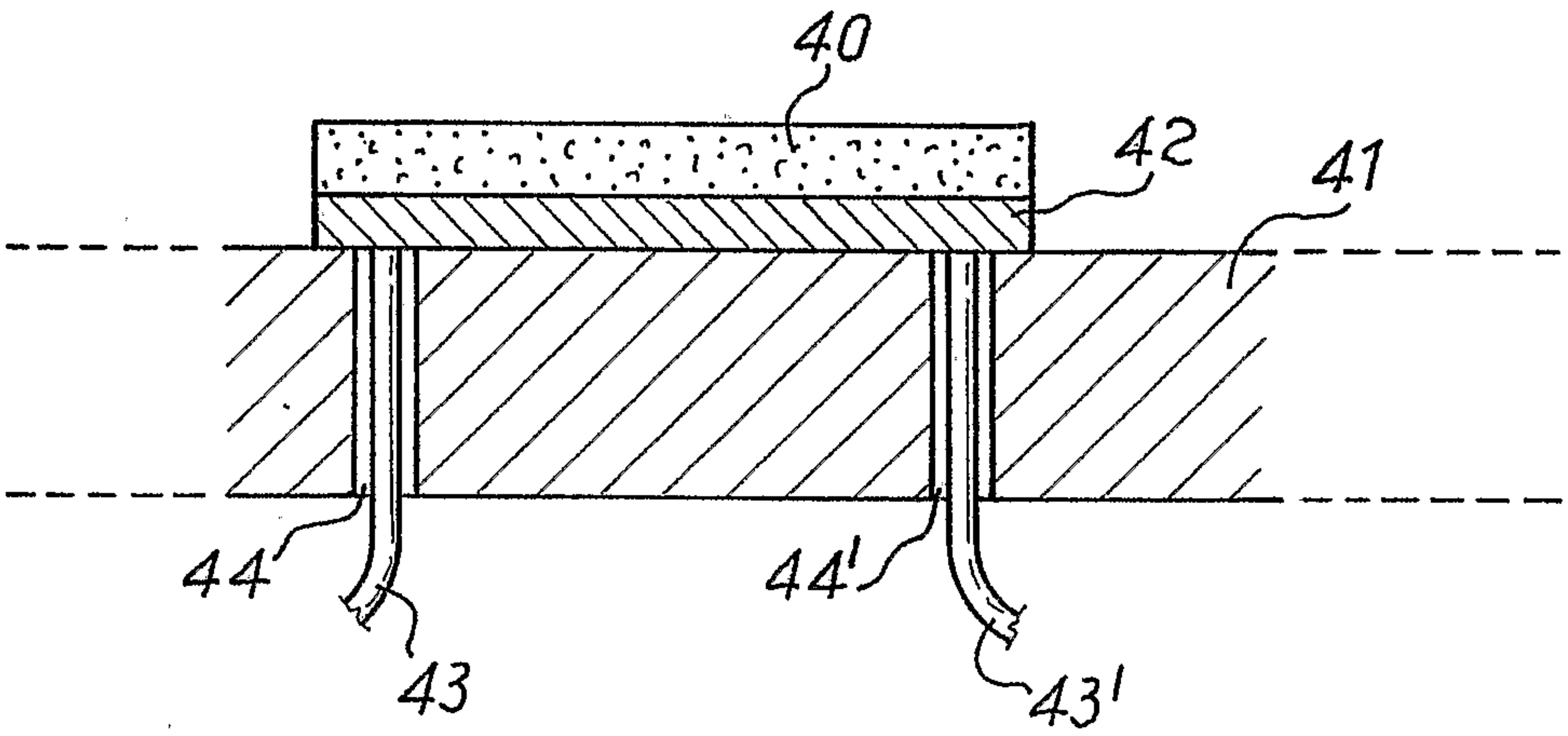


Fig.5

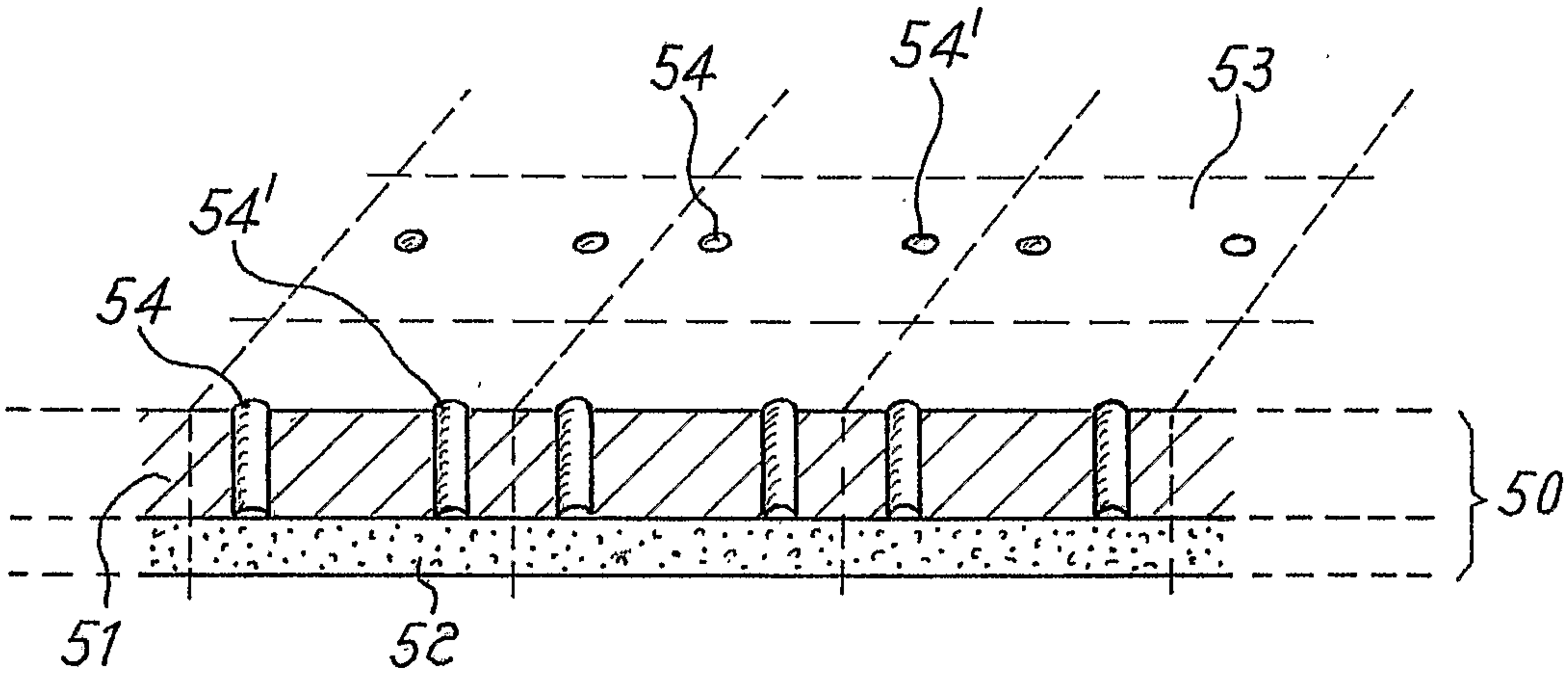


Fig.6

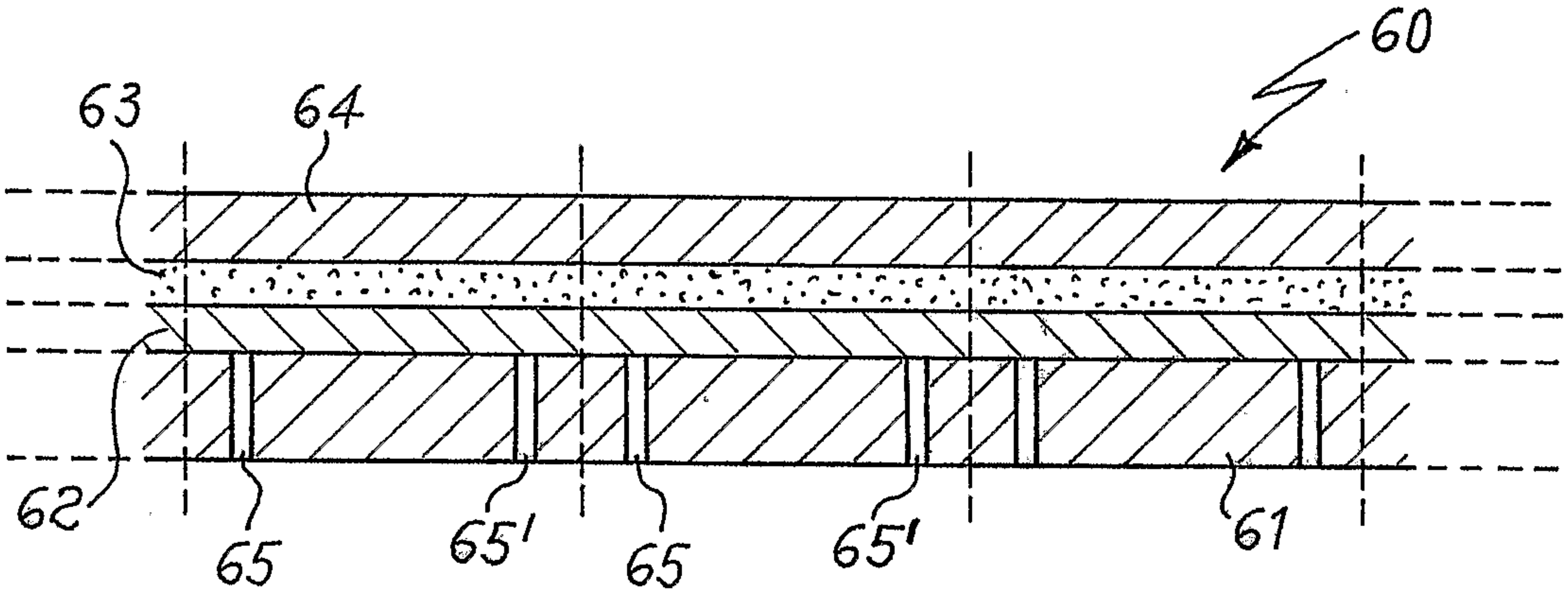
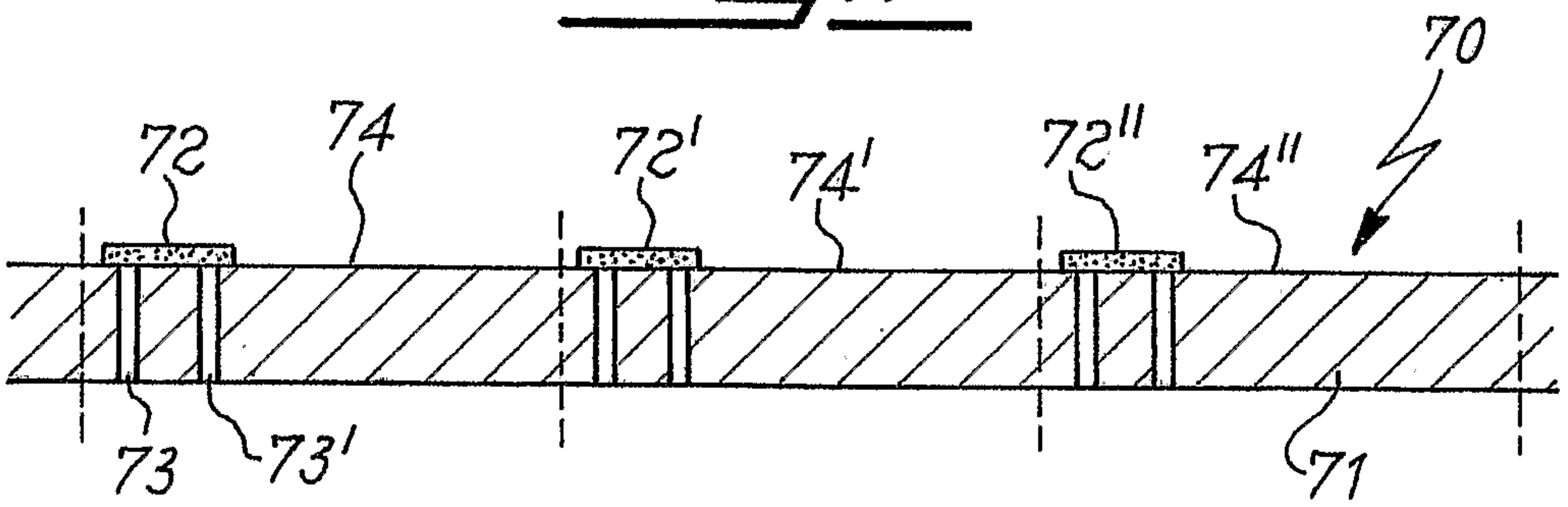
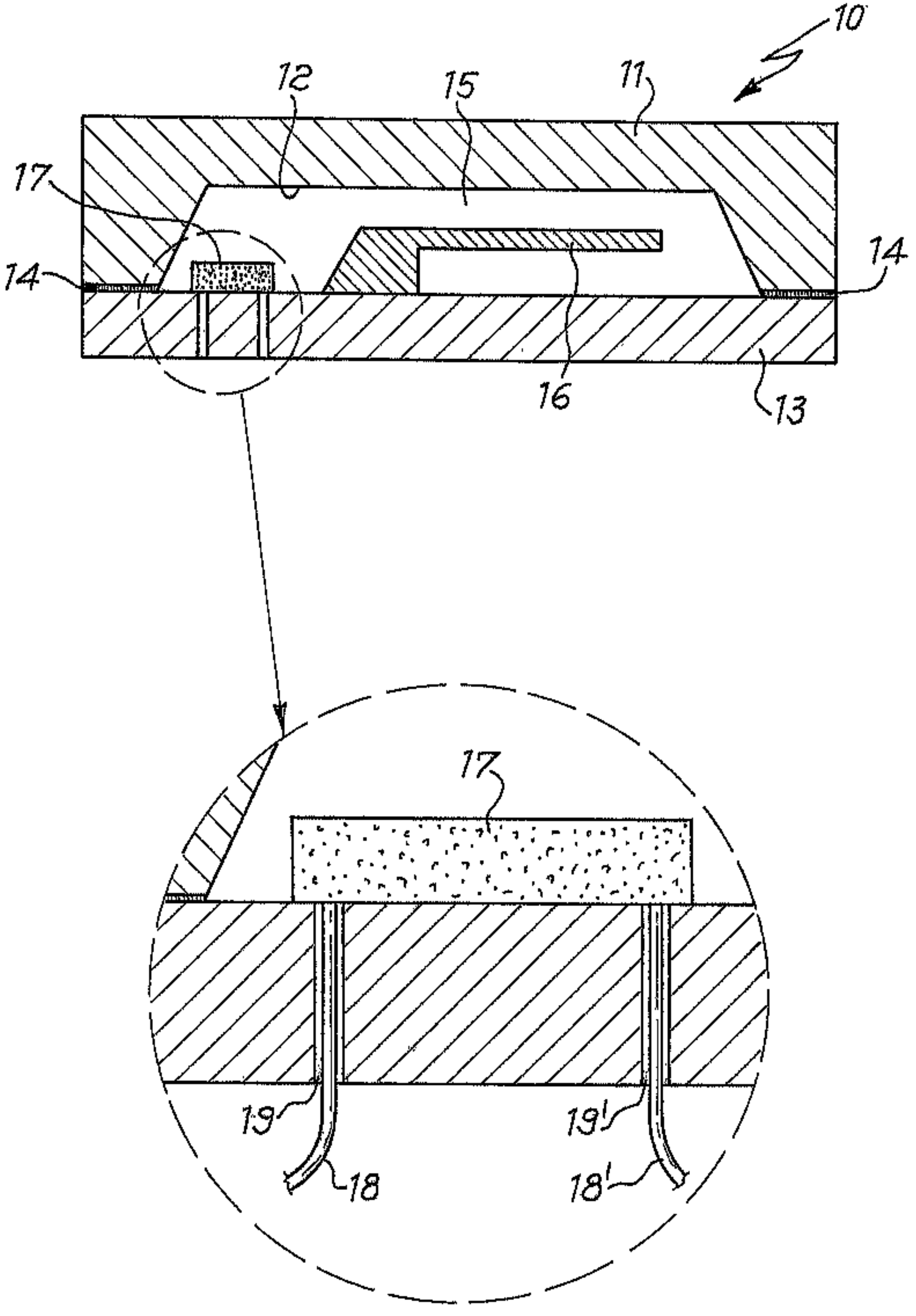


Fig.7

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