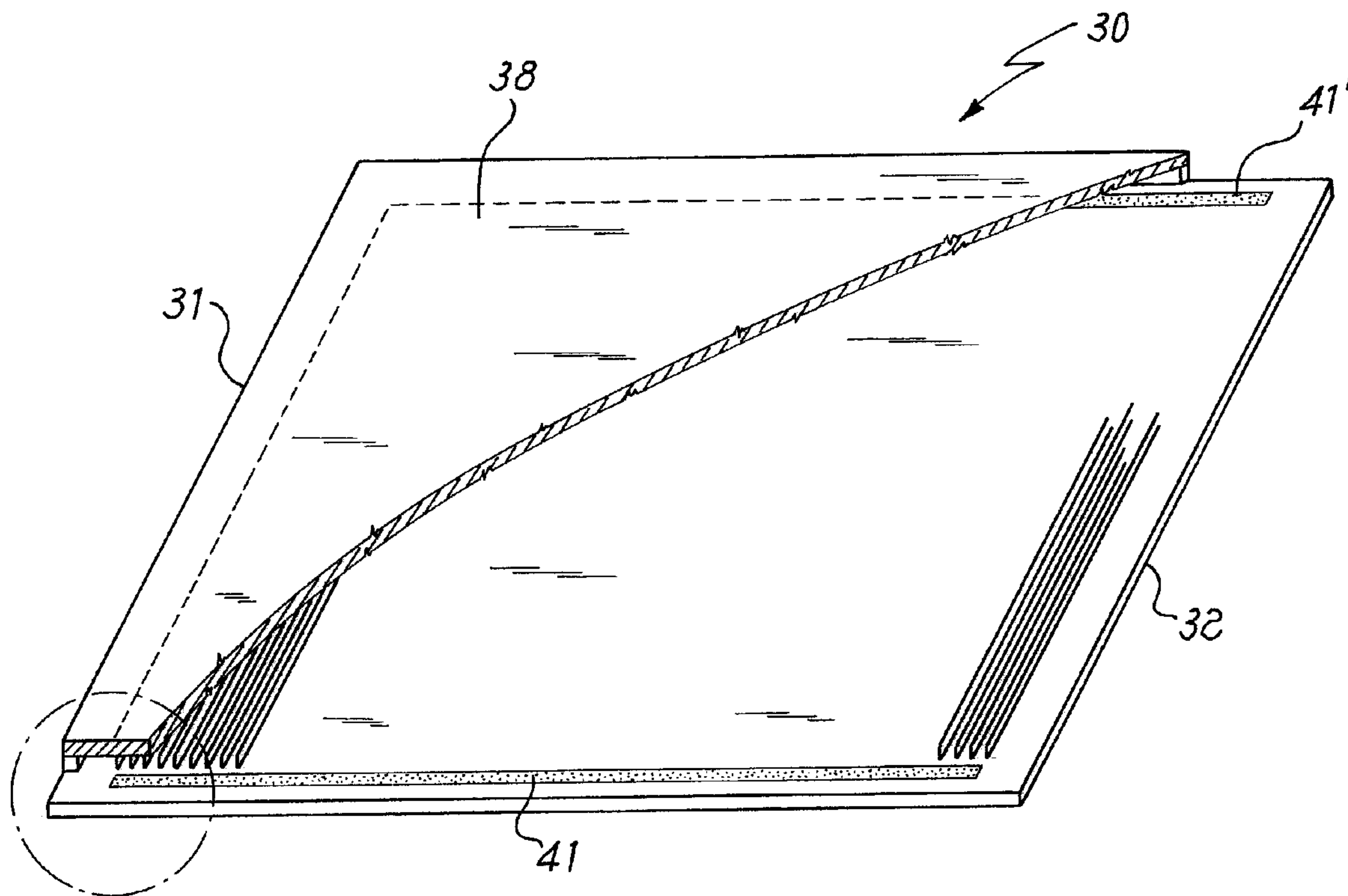




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(57) Abrégé/Abstract:

A getter system is disclosed for plasma flat panels used as screens. By using the getter system of the invention a reduction of the production time is obtained, as well as a better starting quality and the keeping of the starting functional characteristics of these panels.

“GETTER SYSTEM FOR PLASMA FLAT PANELS USED AS SCREENS”

ABSTRACT

- 5 A getter system is disclosed for plasma flat panels used as screens. By using the getter system of the invention a reduction of the production time is obtained, as well as a better starting quality and the keeping of the starting functional characteristics of these panels.

“GETTER SYSTEM FOR PLASMA FLAT PANELS USED AS SCREENS”

The present invention relates to a getter system for plasma flat panels used as screens.

5 Plasma flat panels are studied from about twenty years as possible replacements for conventional cathode-tube screens used e.g. in TV-sets, and their introduction into the market is expected to be imminent.

10 These panels are more usually known in the field under the English denomination “Plasma Display Panels”, or its shortened form “PDP”, which will be hereinafter used.

A PDP is formed of two flat glass members, a front one and a rear one, sealingly joined along their perimeter through a low-melting glass paste. In this way a closed space is formed between the two glass members, which is filled with a mixture of rare gases and wherein there are functional structures as hereinafter
15 described.

The principle of working of a PDP is the conversion into visible light, through the so-called phosphors, of the ultraviolet radiation generated in the rare gas mixture when an electric discharge is produced therein. In case of a screen, in order to form an image, a plurality of small-sized light sources is obviously necessary, and
20 accordingly a plurality of electrode pairs generating localised discharges. The confinement of the electric discharge within an area having small side dimensions is allowed both by the possibility of applying a potential difference to a predetermined single pair of electrodes, and by the fact that the inner space of the PDP is divided into a series of microspaces, possibly in form of parallel channels about 0.1-0.3 mm
25 large: this geometry is diagrammatically shown in Figure 1, which shows the front glass with the broken-line track of a series of electrodes, the parallel channels and the rear glass with a second series of electrodes, orthogonally arranged with respect to the first series, on the bottom of the channels. Alternatively, the PDP inner space may be divided in little cells, also having side dimensions of about 0.1-0.3 mm, in
30 turn connected with parallel channels similar to the former ones; this arrangement is diagrammatically shown in Fig. 2, which shows the front glass (whose surface facing

the PDP inner space carries a series of electrodes, not shown in the figure, similarly to the arrangement described with reference to fig. 1), the cell structure connected with rows of parallel channels and on the rear glass the second series of electrodes, orthogonally arranged with respect to the first series. The image is formed on the front glass member, the actual screen, in correspondence to the channel structures, which fill the whole surface of the PDP except for an edge on the panel perimeter. This perimetral edge, being about 2-15 mm large depending upon the panel dimensions and forming an area with high gas conductance, will be hereinafter referred to also as main channel; the channels in the image forming area have instead side section and gas conductance far smaller than the main channel, and they will be hereinafter referred to also as secondary channels.

The filling of these screens generally consists in a mixture of rare gases, generally helium and neon added with minor amounts of xenon or argon. For a proper working of these devices, it is necessary that the chemical composition of the gas mixture wherein the plasma is formed remains constant. In particular, traces of atmospheric gases, such as nitrogen, oxygen, water or carbon oxides, in the gas mixture result in modifications of the electric working parameters of the PDP, as disclosed in the article of W.E. Ahearn and O. Sahni, "Effect of reactive gas dopants on the MgO surface in AC plasma display panels", published on the journal "IBM J.RES.DEVELOP.", pages 622-625, volume 22, number 6, November 1978. These impurities remain in the panel after the manufacturing process. In fact, the production of these panels comprises, after the perimetral joining of the two glass members, a step of evacuation of the inner space from the atmospheric gases by means of pumps connected thereto through a little hole at a position corresponding to the main channel at the edge of the panel, generally at one of its corners. The limiting factor of the inner space evacuation velocity is the fact that the gas in all the secondary channels flows into the main channel, thus creating therein conditions of accumulation of gas, which can not be quickly removed. The pressure variation in the various areas of the panel during the evacuation has not been studied in depth and the PDP manufacturers adopt evacuation times of several hours, that are empirically determined as a compromise between the conflicting needs of minimising

the time in this process step (and accordingly the production costs) and obtaining residual pressures of atmospheric gases being compatible with the subsequent panel working. Another source of impurities in the plasma screens is the degassing from the materials that make up the same screens, such as e.g. the phosphors, resulting from the heating and the electronic bombardment occurring during the screen working.

In order to remove the impurities during the PDP manufacturing, the Japanese published patent application JP 05-342991 suggests to arrange, along a panel edge, a deposit of porous magnesium oxide, MgO, having direct current connected to its ends; the MgO deposit, when kept under voltage, is capable of sorbing some impurities, such as e.g. water and carbon dioxide. However, once the production process is terminated, the electric contacts with the MgO deposit are disconnected and thus this system does not solve the problem of the gradual increasing of the impurity concentration, occurring in the panel during its service life due to the degassing of its components.

The object of the present invention is to provide a system allowing to overcome the drawbacks of the prior art, in particular to improve the evacuation process of the PDPs and to sorb the gas impurities generated inside the panels during their service life.

These objects are achieved according to the present invention by a getter system for plasma flat panels being used as screens, formed of one or more non-evaporable getter devices arranged in the main channel in at least one of the two areas adjacent to the panel sides perpendicular to the direction of the secondary channels. Preferably, the getter system of the invention is formed of two or more non-evaporable getter devices arranged in the main channel in both the areas adjacent to the panel sides perpendicular to the direction of the secondary channels.

Non-evaporable getter materials or devices are known in the vacuum field under the name of NEG (Non-Evaporable Getter) materials or devices, and so they will be hereinafter referred to.

The invention will be hereinafter described with reference to the drawings, wherein:

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- Figure 1 and 2 diagrammatically show the inner structure of two possible types of plasma flat panels;

- Figure 3 shows a cutaway view of a flat plasma panel containing a getter system according to the invention;

5 - Figure 3a shows in an enlarged scale a detail of Figure 3; and

- Figure 4 shows, in a view similar to the one of Figure 3a, a PDP containing a different type of getter system of the invention.

The following description of the invention will be made with reference to a plasma panel having a structure with simple channels, of the type shown in Figure 1,
10 since the structure with cells connected to the channels, shown in Figure 2, is substantially equivalent to the former case as for the problems the present invention aims to solve.

For the sake of clarity, Figures 3 and 3a show only the main geometry of a plasma panel, whereas they do not show some functional parts, such as the deposits
15 of electroconductors materials forming the electrodes or the phosphors deposits in the channels. Referring to Figures 3 and 3a, a flat plasma panel 30 is formed of a front glass member 31 and a rear one 32, sealingly joined to each other by melting a low-melting glass paste 33 placed in a perimetral area 34. In the inner space there is a structure with channels 35, 35', ..., defined by walls 36, 36', The represented
20 channel structure extends for most of the panel surface, except for an edge 37, and corresponds to area 38 of member 31, which forms the real screen. At a location corresponding to edge 37, there is the main channel 39, having the same width as edge 37 (ranging from 2 to 15 mm, as previously said) and height equal to the distance between members 31 and 32, ranging from 0.2 to 0.3 mm. Since walls 36,
25 36', ... contact member 31 on the top and member 32 on the bottom, the space comprised in each secondary channel is connected to the rest of the inner PDP space only through openings 40, 40',

The NEG devices forming the system of the invention are arranged in at least one, preferably both areas 41, 41' facing openings 40, 40', ... and adjacent to the
30 panel sides perpendicular to the direction of the secondary channels. In putting the system of the invention into practice, NEG devices may physically contact only

member 31, only member 32 or both these members. In all these cases the geometry of the NEG devices and of the whole getter system must be such as not to exceedingly reduce the gas conductance in channel 39. This condition may be complied with, when NEG devices contact only one of members 31 or 32, by using
5 devices which only partially fill up areas 41, 41', or, as Figure 3a shows, devices 42 completely filling up these areas and being not thicker than, e.g., half the height of channel 39. On the contrary, when NEG devices contact both members 31 and 32, as Figure 4 shows, devices 43, 43', ... may be arranged so as not to contact one another.

10 NEG devices forming the system of the invention may be in not-supported form, such as e.g. sintered pellets of NEG material powders, or in supported form, such as e.g. deposits of powders onto metal tape.

The production of NEG material pellets is well known in the field, and generally comprises a step of powder compression in a suitably sized mould and a
15 subsequent clotting of the pellet by a thermal sintering treatment.

When using NEG devices in form of pellets, it is preferable to provide seats 44, as shown e.g. in Figure 4, in form of grooves in the surface of one or both members 31 and 32, in order to favour an accurate and steady positioning of the pellets; moreover, this possibly allows to increase the pellet thickness and thus the
20 amount of NEG material in the PDP, or, instead, the pellet thickness being the same, to increase the gas conductance in channel 39.

Supported NEG devices may be obtained by arranging the powders directly on one of members 31 or 32, preferably by screen-printing. In such a technique, wet pastes are deposited comprising a powder of the material to be deposited and a
25 suspending means keeping the proper fluidity of the paste. By using screens of generally synthetic fabrics, which are laid on the deposit support, and selectively clogging some of the screen meshes, it is possible to obtain a localised deposit having the desired geometry. Once the wet deposit is obtained, it is first dried in air or in an oven in order to remove most of the volatile compounds in the paste, and
30 then clotted by a thermal treatment at high temperatures, generally ranging from 700 to 1000 °C. By this technique, it is possible to obtain NEG material deposits on

virtually any material, including glass. As for the details of the technique, PCT laid-open patent application WO 98/03987, in the applicant's name, should be referred to.

An additional support is preferably used for supported NEG devices. A wide
5 variety of techniques may be used for producing a NEG device comprising an additional support, including e.g. cold lamination, electrophoresis, spray techniques and screen-printing. Cold lamination is well known in the field of powder deposits; for this specific application, NEG material powders are used having a particle size ranging from about 0.1 to 0.15 mm, and a support in form of metal tape, preferably
10 made of nickeled iron or constantan. Supports of materials being electroconductors, e.g. metals, are used for preparing NEG material deposits by the electrophoretic technique; as for the details of the preparation of NEG material deposits according to this technique, US patent 5242559, in the applicant's name, should be referred to. In the spray technique, diluted suspensions of NEG materials are used, which are
15 sprayed onto the hot substrate, and in this case there are no specific limitations about the substrate material; as for the details of the production of NEG material deposits according to this technique, laid-open patent application WO 95/23425, in the applicant's name, should be referred to. Finally, the screen-printing technique has been already mentioned above. Anyhow, when using an additional support, the
20 deposit is preferably produced by first covering with NEG material the whole surface of a large-sized support, and then cutting therefrom strips of the desired dimensions. The preferred materials for the additional support are nickel, titanium, nickel-chromium or nickel-chromium-iron alloys, etc..

Both when the NEG material deposit is directly obtained on one of members
25 31 or 32, and when it is obtained on an additional support, a deposit seat may be provided in form of a groove in the glass of members 31 or 32, in order to minimise the conductance reduction of openings 40, 40',

A wide variety of NEG materials may be used for preparing the deposits of the invention, generally comprising titanium or zirconium, their alloys with one or
30 more elements selected among transition metals and aluminium, and mixtures of one or more of these alloys with titanium and/or zirconium. Among the NEG materials

more commonly used, there are the alloy having weight percent composition Zr 70% - V 24.6% - Fe 5.4%, manufactured and sold by the applicant under the tradename St 707TM; the alloy having weight percent composition Zr 84% - Al 16%, manufactured and sold by the applicant under the tradename St 101[®]; the alloy
5 having weight percent composition Zr 76.5% - Fe 23.5%, manufactured and sold by the applicant under the tradename St 198TM; the alloy having weight percent composition Zr 76% - Ni 24%, manufactured and sold by the applicant under the tradename St 199TM; and a mixture comprising 60% by weight of St 707TM alloy and 40% by weight of zirconium, manufactured and sold by the applicant under the
10 tradename St 172. These alloys are used in form of powders having a particle size ranging from 0.1 to 0.15 mm, when applied by cold lamination on the support, or smaller than 128 μm (preferably smaller than 60 μm) with other application techniques. In order to perform their function, these alloys require a thermal activation at temperatures ranging from about 350 to 450 °C; the activation may be
15 carried out at the same time as the joining of members 31 and 32, during which temperatures of about 400-500 °C are reached, necessary for melting paste 33, or by subsequent thermal treatments, as known in the field.

By using the getter system of the invention, several advantages are obtained, both in the PDP production and during their service life. During the PDP
20 production, the getter system of the invention acts as additional pump directly introduced into the main channel, thus preventing the problems related to the gas discharge through this channel and allowing to reach lower residual pressures in the PDP, thereby reducing the pumping time.

During the PDP service life, the getter system of the invention acts instead as
25 a constantly active pump which continuously removes the impurities produced by the degassing of materials forming the panel, thereby keeping constant the composition of the mixture of rare gases therein.

CLAIMS

1. A plasma display panel (30) used as a screen, said panel comprising a front glass member (31) and a rear glass member (32) sealingly joined to each other, a main channel (39), secondary channels (35, 35', ...) and a getter system, with said main channels, secondary channels and getter system placed between said glass members, wherein said getter system is formed of one or more non-evaporable getter devices (42; 43, 43', ...) arranged in said main channel (39) in at least an area (41, 41') adjacent to the panel sides perpendicular to the direction of said secondary channels (35, 35', ...).
2. A plasma display panel according to claim 1, wherein the getter system is formed of at least two non-evaporable getter devices arranged in the main channel (39) in both the areas (41, 41') adjacent to the panel sides perpendicular to the direction of the secondary channels (35, 35', ...).
3. A plasma display panel according to claim 1, wherein the non-evaporable getter devices (42; 43, 43', ...) contact only one of the glass members (31, 32) forming the panel.
4. A plasma display panel according to claim 1, wherein the non-evaporable getter devices (42) continuously cover one or both the areas (41, 41') adjacent to the panel sides perpendicular to the direction of the secondary channels (35, 35', ...) and are not thicker than half the height of the main channel (39).
5. A plasma display panel according to claim 1, wherein the non-evaporable getter devices (43, 43', ...) contact both the glass members (31, 32) forming the panel.
6. A plasma display panel according to claim 5, wherein the non-evaporable getter devices (43, 43', ...) discontinuously cover one or both the areas (41, 41') adjacent to the panel sides perpendicular to the direction of the secondary channels (35, 35', ...).
7. A plasma display panel according to claim 1, formed of non-evaporable getter devices not comprising a support.
8. A plasma display panel according to claim 7, wherein the non-evaporable getter devices are arranged in seats (44) provided in the surface of one or both the glass members (31, 32) forming the panel.

9. A plasma display panel according to claim 1, formed of non-evaporable getter devices comprising a support.
10. A plasma display panel according to claim 9, wherein the non-evaporable getter devices are arranged in grooves provided in one or both the glass members (31, 32) forming the panel.
11. A plasma display panel according to claim 9, wherein the getter system is formed of devices consisting of powders of non-evaporable getter material directly deposited onto one of the glass members (31, 32) forming the panel.
12. A plasma display panel according to claim 11, wherein the powders of non-evaporable getter material are deposited by screen-printing.
13. A plasma display panel according to claim 9, wherein the getter system is formed of devices consisting of powders of non-evaporable getter material deposited onto an additional support.
14. A plasma display panel according to claim 13, wherein the powders of non-evaporable getter material are deposited by screen-printing.
15. A plasma display panel according to claim 13, wherein the powders of non-evaporable getter material are deposited by electrophoretic technique.
16. A plasma display panel according to claim 13, wherein the powders of non-evaporable getter material are deposited by spray technique.
17. A plasma display panel according to claim 13, wherein the support is a metal tape.
18. A plasma display panel according to claim 17, wherein the one or more non-evaporable getter devices are produced by laminating powders onto the support.
19. A plasma display panel according to claim 1, wherein the getter material is selected among titanium and zirconium, their alloys with one or more elements selected among transition metals and aluminum, and mixtures of one or more of these alloys with titanium and zirconium, in form of powders having a particle size smaller than 0.15 mm.
20. A plasma display panel according to claim 1, wherein the getter material is selected among titanium and zirconium, their alloys with one or more elements selected among transition metals and aluminum, and mixtures of one

or more of these alloys with titanium, in form of powders having a particle size smaller than 0.15 mm.

21. A plasma display panel according to claim 1, wherein the getter material is selected among titanium and zirconium, their alloys with one or more elements selected among transition metals and aluminum, and mixtures of one or more of these alloys with zirconium, in form of powders having a particle size smaller than 0.15 mm.
22. A plasma display panel according to claim 18, wherein the powders have a particle size ranging from 0.1 to 0.15 mm.
23. A plasma display panel according to any one of claims 19 to 21, wherein the powders have a particle size smaller than 128 μm .
24. A plasma display panel according to any one of claims 19 to 21, wherein the getter material is an alloy having weight percent composition Zr 70% - V 24.6% - Fe 5.4%.
25. A plasma display panel according to any one of claims 19 to 21, wherein the getter material is an alloy having weight percent composition Zr 84% - Al 16%.
26. A plasma display panel according to any one of claims 19 to 21, wherein the getter material is an alloy having weight percent composition Zr 76.5% - Fe 23.5%.
27. A plasma display panel according to any one of claims 19 to 21, wherein the getter material is an alloy having weight percent composition Zr 76% - Ni 24%.
28. A plasma display panel according to any one of claims 19 to 21, wherein the getter material is a mixture comprising 60% by weight of the alloy having weight percent composition Zr 70% - V 24.6% - Fe 5.4% and 40% by weight of zirconium.

Fig. 1

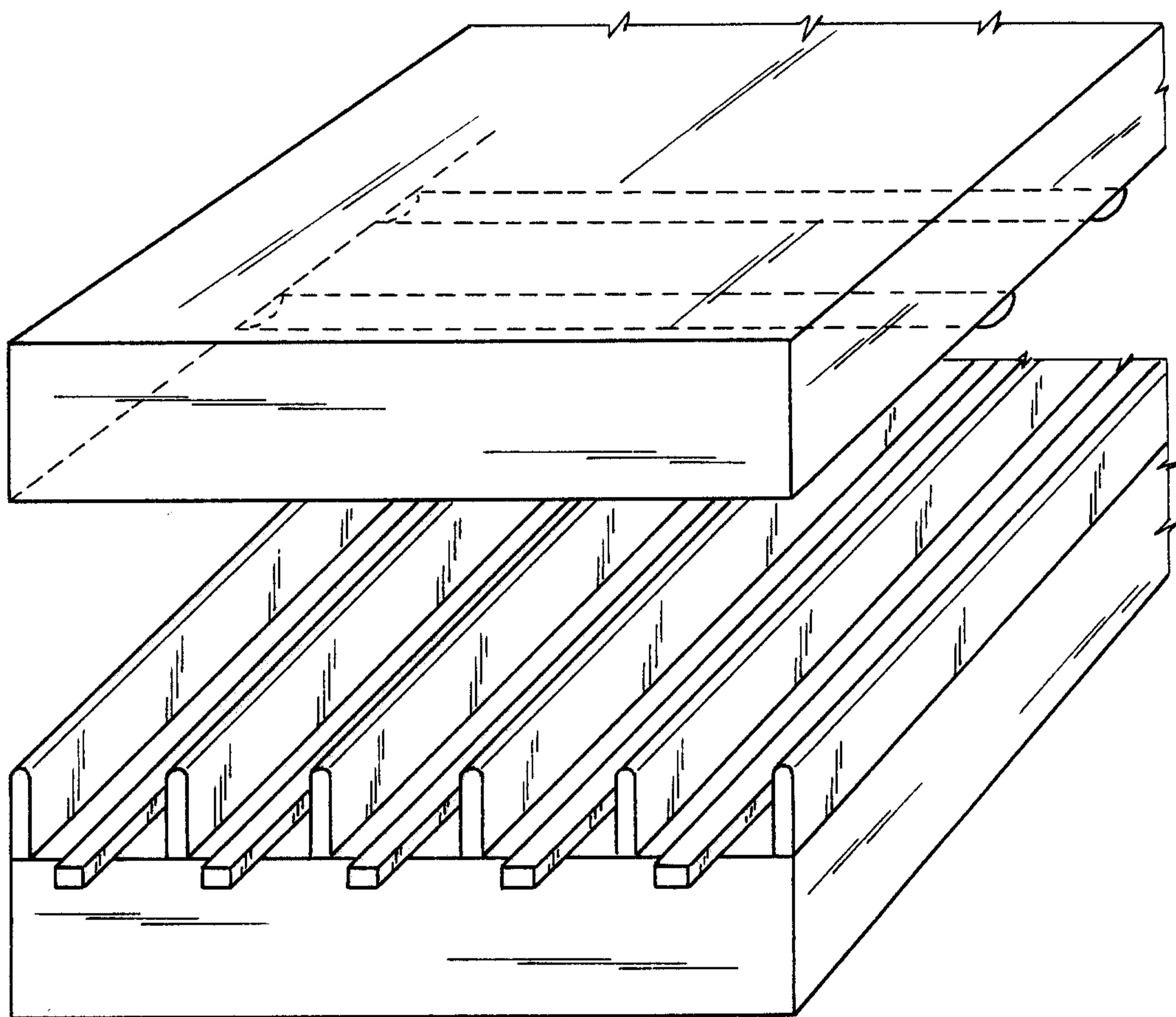


Fig. 2

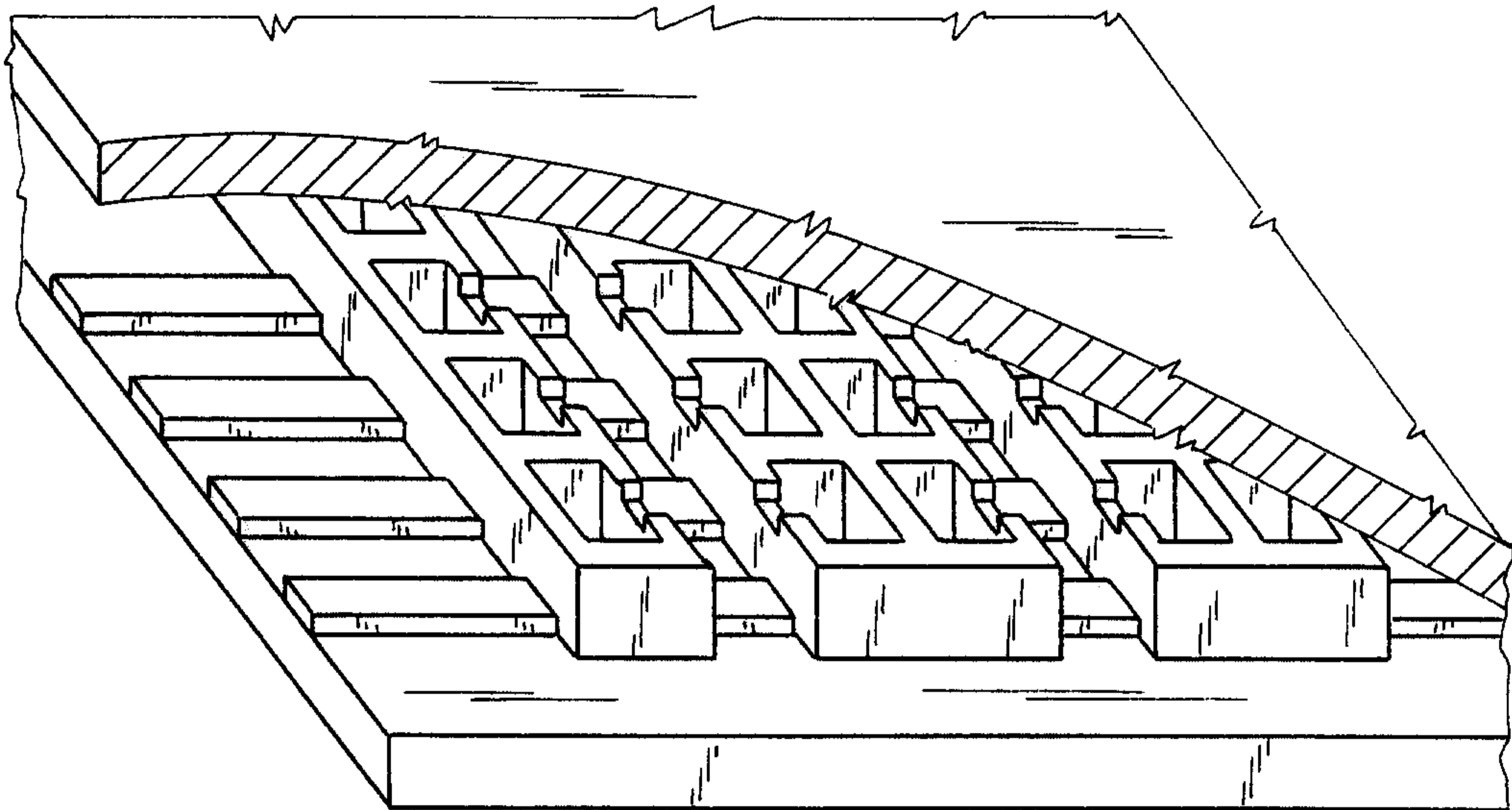
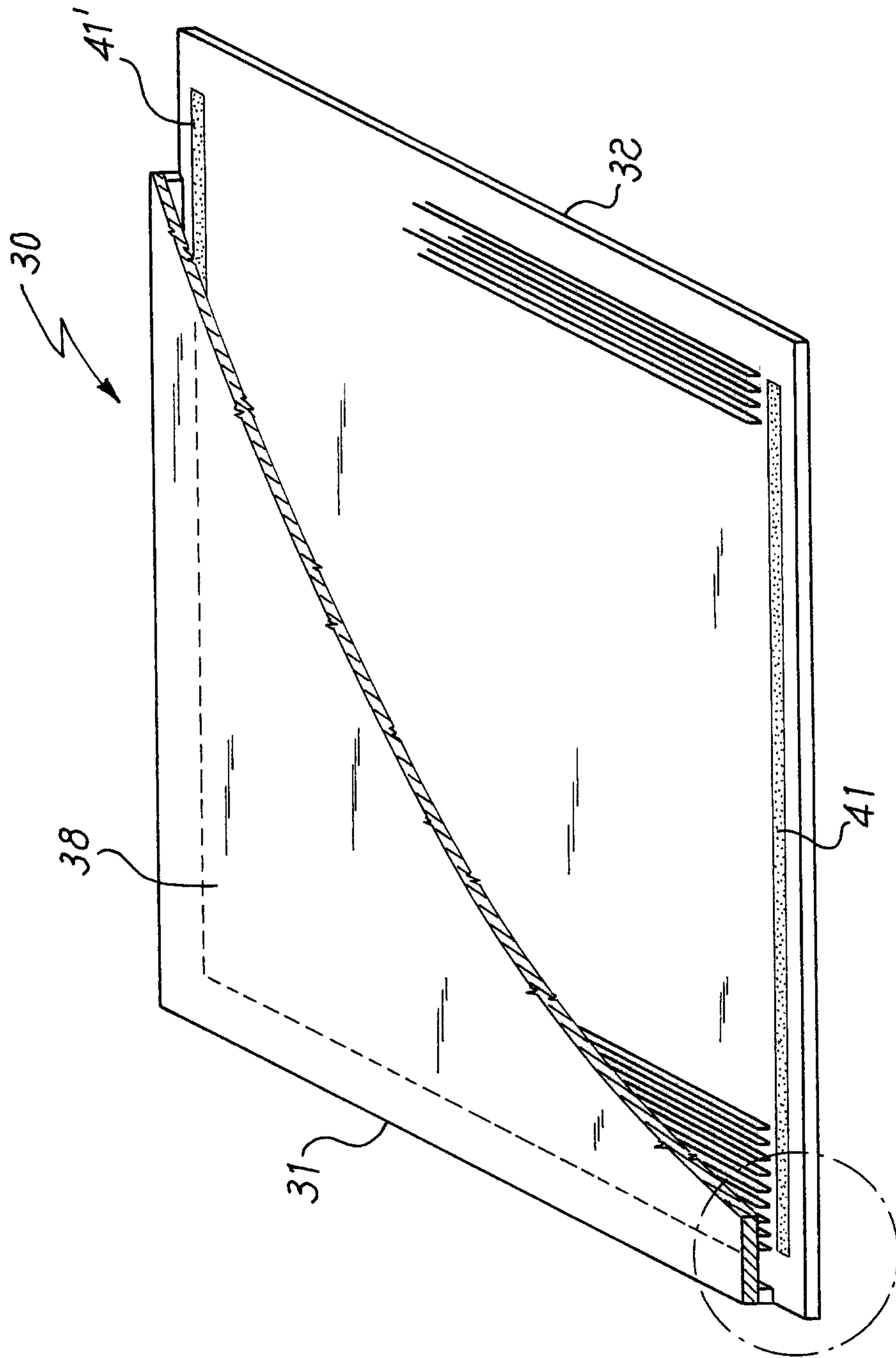


Fig. 3



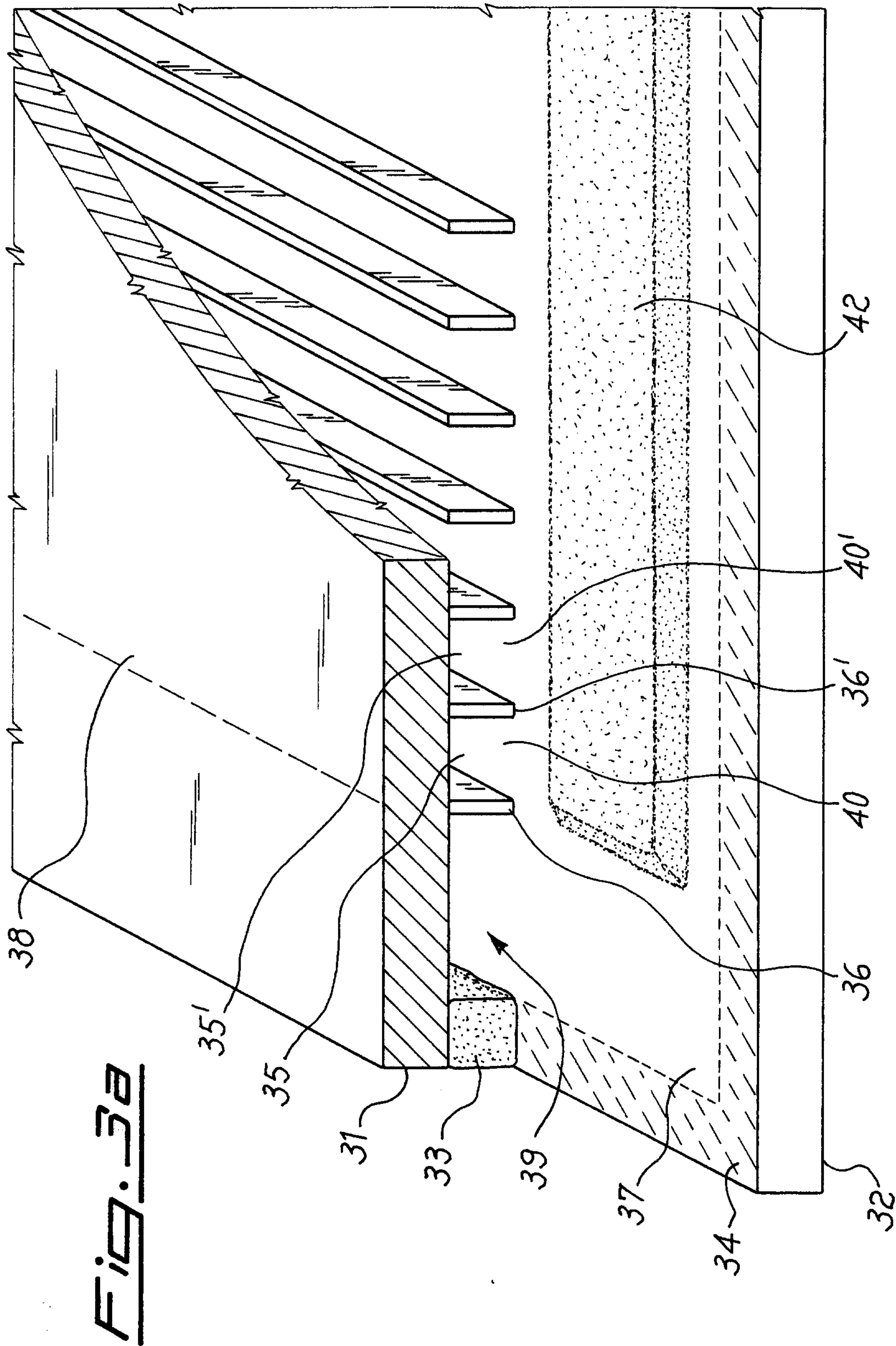


Fig. 3a

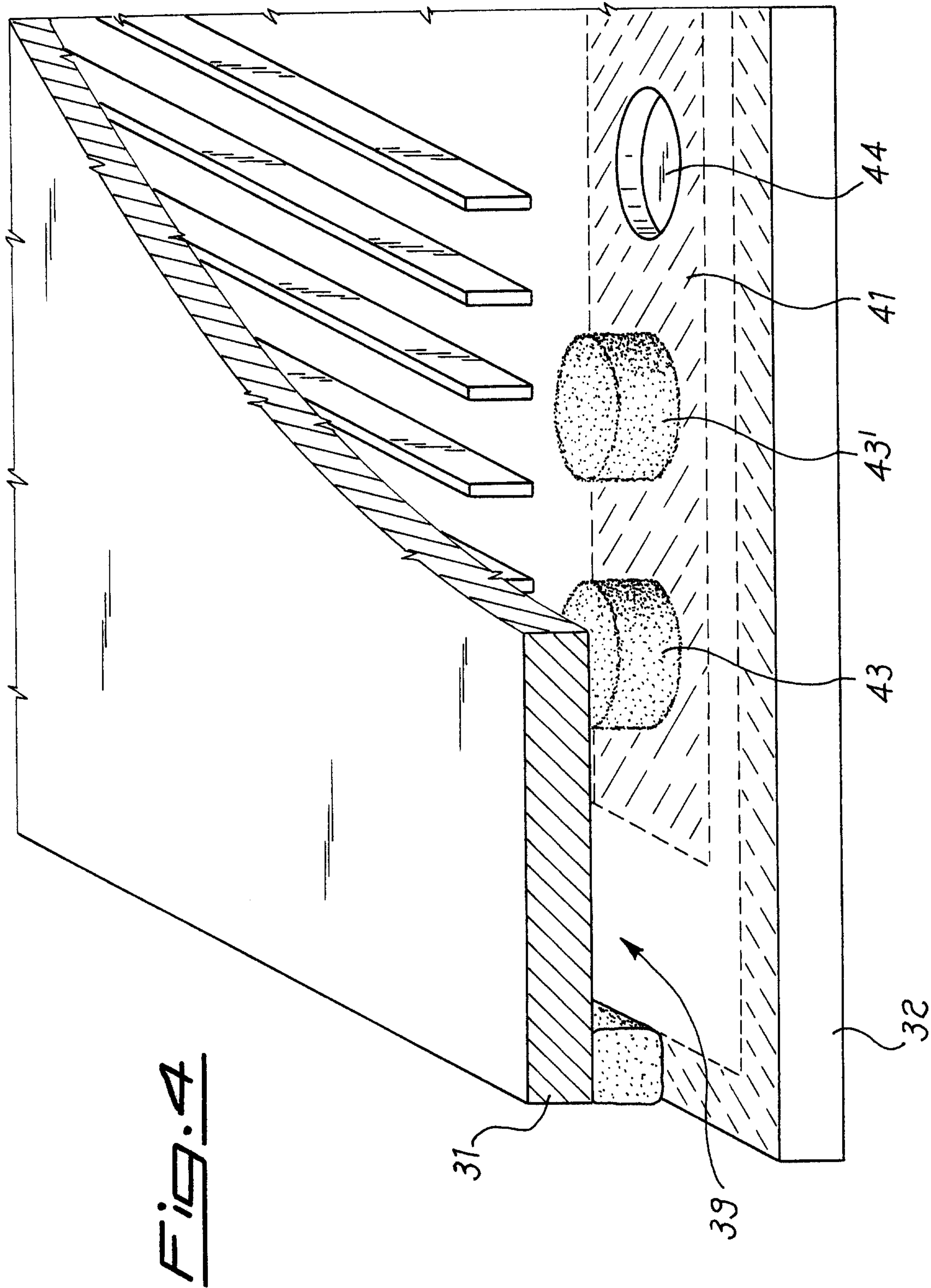


FIG. 4

