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[54] **GAS-DISCHARGE DISPLAY PANELS**

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[51] **Int. Cl.** **H01j 61/00**

[58] **Field of Search** 313/188, 201, 210, 220

[56] **References Cited**

UNITED STATES PATENTS

3,716,742	2/1973	Nakayama et al.	313/220
3,634,719	1/1972	Ernsthausen	313/210

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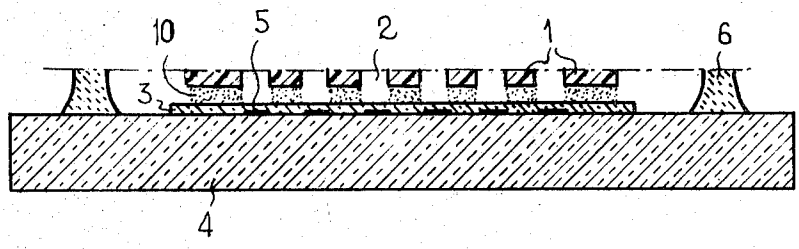
[57] **ABSTRACT**

In gas-discharge display panels consisting of a matrix (1) clamped between two films of insulating material (3) separating it from two networks of electrodes (5), the invention provides for the interposition between said matrix and said insulating material films, of a refractory metal oxide or silicon powder material (10) mixed with a binder, in order to avoid the matrix and the two films of insulating material to stick to one another during the high-temperature operations to which the panel is submitted during its manufacture ; said powder material is preferably a refractory metal oxide.

6 Claims, 2 Drawing Figures



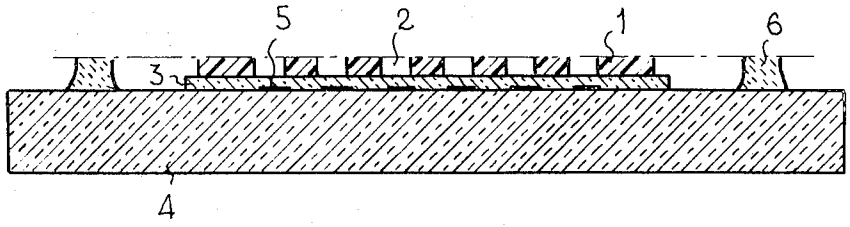


FIG. 1

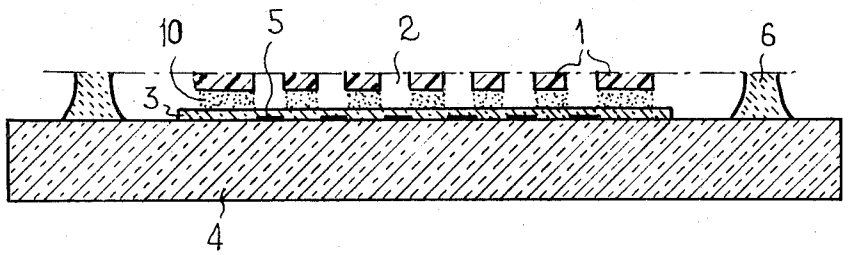


FIG. 2

GAS-DISCHARGE DISPLAY PANELS

The present invention relates to an improvement in gas-discharge display panels.

In the following, the structure of these panels, which are also referred to hereinafter as plasma panels, will be recapitulated.

These panels comprise a matrix in the form of a perforated plate, with, disposed at either side of it and in its immediate neighbourhood, two networks of linear electrically conductive electrodes crossing each other in pairs over said holes. These networks are generally formed on two thick slabs applied against the matrix with those of their faces carrying the network facing said matrix, said networks being coated with two films of insulating material. Arrangements are made to maintain a gas filling between the two slabs inside a circumference surrounding the matrix.

It should be added, too, that under the effect of the voltage applied between two of the electrodes belonging one to the first network and the other to the second, the gas contained in the hole located at the point of their intersection is ionised and thus this point displayed.

Amongst the components of which these panels are made up, a substantial proportion are made of glass or some similar material.

This remark applies first of all to the slabs which, since they have to be transparent, or at any rate if not both at least one of them, to provide a display, are generally both made of this material ; it applies too to the matrix itself which, since it has to be an insulator is also sometimes made of glass, and finally to the insulating films through which the slabs rest upon the matrix.

Consequently, in many cases an examination of these panels shows a fairly uniform use of glass or vitreous materials of various kinds.

This has the drawbacks which are inherent in the operations to which the panel is subjected during the course of its manufacture, certains of which take place at relatively high temperatures, as much as 400° to 450°C.

As a mater of fact, at temperatures of this order all these materials, which characteristically have no clear melting point, start to soften.

The consequence of this softening is that components which are in contact with one another stick together, for example the matrix on the one hand and the layers of insulating material which cover the networks of electrodes, on the other. These layers or films are sometimes also constituted by thin glass plates. On cooling, the adhesion prevents the return of the components to their initial dimensions so that cracking and sometimes even breakage can occur, impairing the proper operation of the panel.

During the course of this softening, it may also happen that the material of the insulating plates partially flows into the holes formed in the matrix and this, obviously, interferes with proper operation.

The object of the present invention is a structure which will avoid these drawbacks.

To overcome these drawbacks, the invention provides for the addition of an element to those normally encountered in the prior art structures. This element consists of a film of insulating material arranged between the matrix and the insulating films or plates which cover the network of conductive electrodes. This

film consists of a mixture of a powder material and a binder, which, owing to the low adhesion of the grains of powder material between one another, prevents the sticking observed in the prior art designs and makes it possible for the component parts of the panel to execute displacements in relation to one another during the heating operations to which it is submitted.

These relative displacements are made necessary by the differing coefficients of expansion of the components when same are not all made of strictly identical materials.

According to the invention, there is provided a gas-discharge display panel comprising a matrix in the form of a perforated plate and, at either side thereof, two networks of linear electrically conductive electrodes, an electrode of one of the networks and an electrode at the other intersecting one another opposite one of said holes, the conductors of each of said networks being separated from the matrix by a film of insulating material in contact with the matrix, characterized in that said matrix is covered on each of its faces in contact with said films, with a supplementary insulating film constituted by a mixture of powder material and a binder.

In accordance with a preferred embodiment of the invention, the powder material is a refractory material, that is to say one having a high melting point, in all cases much higher than that of the pieces of which the panel is made.

The invention will be better understood from a consideration of the ensuing description and the attached figures where, similar references designating similar elements :

FIG. 1 illustrates a partial view of a prior art plasma panel ;

FIG. 2 illustrates the foregoing partial view, modified in accordance with the invention.

FIG. 1 illustrates the bottom half of a gas-discharge display panel. The top half, not shown, is identical to the bottom half with the exception that it contains the pumping and filling pipe.

In FIG. 1, the matrix 1 with the holes 2, the network of linear electrodes 5 deposited on the slab 4 and covered by the insulating plate 3, and, surrounding the matrix, the bond zone 6 between the slab 4 and the second slab identical to it but not shown in the figure, this zone delimiting around the matrix the compartment which is filled with gas, can be seen.

In FIG. 2, the same elements as those shown in the preceding figure can be seen, plus the insulating film 10 in accordance with the invention which is constituted by a powder material mixed with a binder.

The powder material in question can be chosen from a wide variety of materials ranging from silica powder to metal oxides of refractory metals, that is to say ones having a high melting point.

The binder which is present in a small proportion in the mixture can be one of the conventional bonds used in electron tubes work, for example a metal-alkaline silicate such as potassium silicate.

The preparation of the panel in accordance with the invention takes place as follows :

The matrix is prepared in accordance with the prior art, for example in the form of a glass plate five-tenths mm in thickness, pierced by a right-angled network of holes five-tenths mm in diameter. There is atomised onto the two faces of the matrix, using a suitable gun, a liquid

suspension containing 50 percent by weight of chrome oxide whose grain size ranges between 10 and 20 microns, a few percent of potassium silicate and the remainder water, in order to produce a film having a thickness of between 20 and 50 microns. After drying in contact with the atmosphere, the matrix is mounted in the panel in the manner described in the prior art. The potassium silicate effects a bond between the particles of chrome oxide whose proportion by weight in the film **10**, at the end of the preparation of the matrix, is in the order of 90 percent.

The presence of this intermediate film means that during the high-temperature operations referred to hereinbefore, the adhesion observed in the prior art panels, between matrix and insulating plates, is avoided, the more so in fact the greater the interval between the melting point of the powder material and the maximum temperature applied to the tube during the course of its manufacture. In addition, the action of the binder is sufficiently weak to allow the grains which make up the film in accordance with the invention a certain degree of latitude to displace in relation to one another, thus preventing the problems of differential expansion hereinbefore referred to.

In addition, during the later operations of manufacturing the panel in particular during those involving high temperatures the film **10** fills up the irregularities in the insulating plate **3.**

Finally, in certain cases this film is coloured in order to improve contrast. In particular, if chrome oxide is used it has a dark green colour.

What I claim is:

1. A gas-discharge display panel comprising a matrix in the form of a perforate plate having a plurality of holes therein and, at either side thereof, two networks of linear electrically conductive electrodes, an electrode of one of the networks and an electrode at the other network intersecting one another opposite one of said holes, the conductors of each of said networks being separated from the matrix by a film of insulating material in contact with the matrix, wherein said matrix is covered substantially only on each of its faces in contact with said films with a supplementary insulating film comprising a mixture of a powdered material selected from the group consisting of silica and at least one refractory metal oxide; said powdered material having a high melting point, and a binder therefor such that, when the display panel is subjected to heat, the powdered material of the insulating film provides for relative movement between the matrix and the insulating material, upon heating and subsequent cooling.

2. A display panel as claimed in claim **1** wherein said refractory material is chrome oxide.

3. A display panel as claimed in claim **1** wherein said supplementary insulating films have a thickness of between 20 and 50 microns.

4. A display panel as claimed in claim **1** wherein said powder material has a grain size of between 10 and 20 microns.

5. A display panel as claimed in claim **1** wherein said binder is an alkaline metal silicate.

6. A display panel as claimed in claim **1** wherein the proportions by weight of said powder material and said binder in said supplementary insulating film, are respectively 95 and 5 percent.

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