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[54] **GASEOUS DISPLAY PANEL HAVING TWO ARRAYS OF GAS CELLS**
 3 Claims, 8 Drawing Figs.

[52] U.S. Cl..... **313/220,**
 315/84.6, 315/169 TV
 [51] Int. Cl..... **H01J 61/30**
 [50] Field of Search..... 315/169 R,
 169 TV, 84.6; 313/109.5, 220

ABSTRACT: A display panel comprises a plurality of insulating plates, between which several arrays of electrodes are secured. The panel is assembled by first preparing at least one subassembly comprising an array of electrodes secured to an insulating plate and then sealing the various parts together.

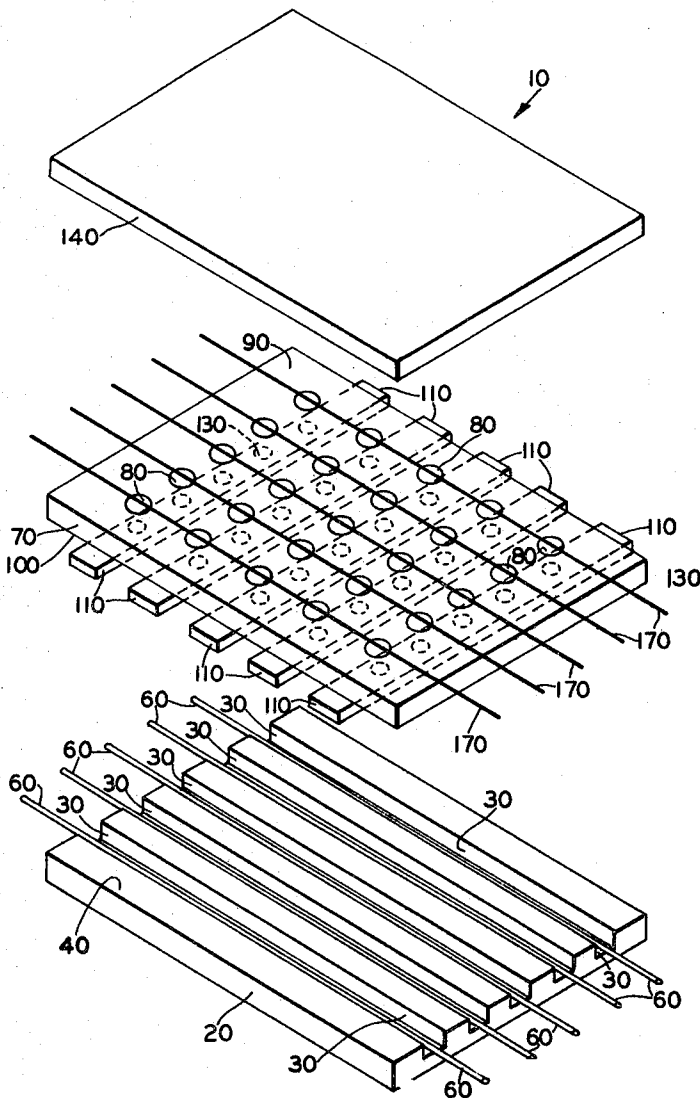
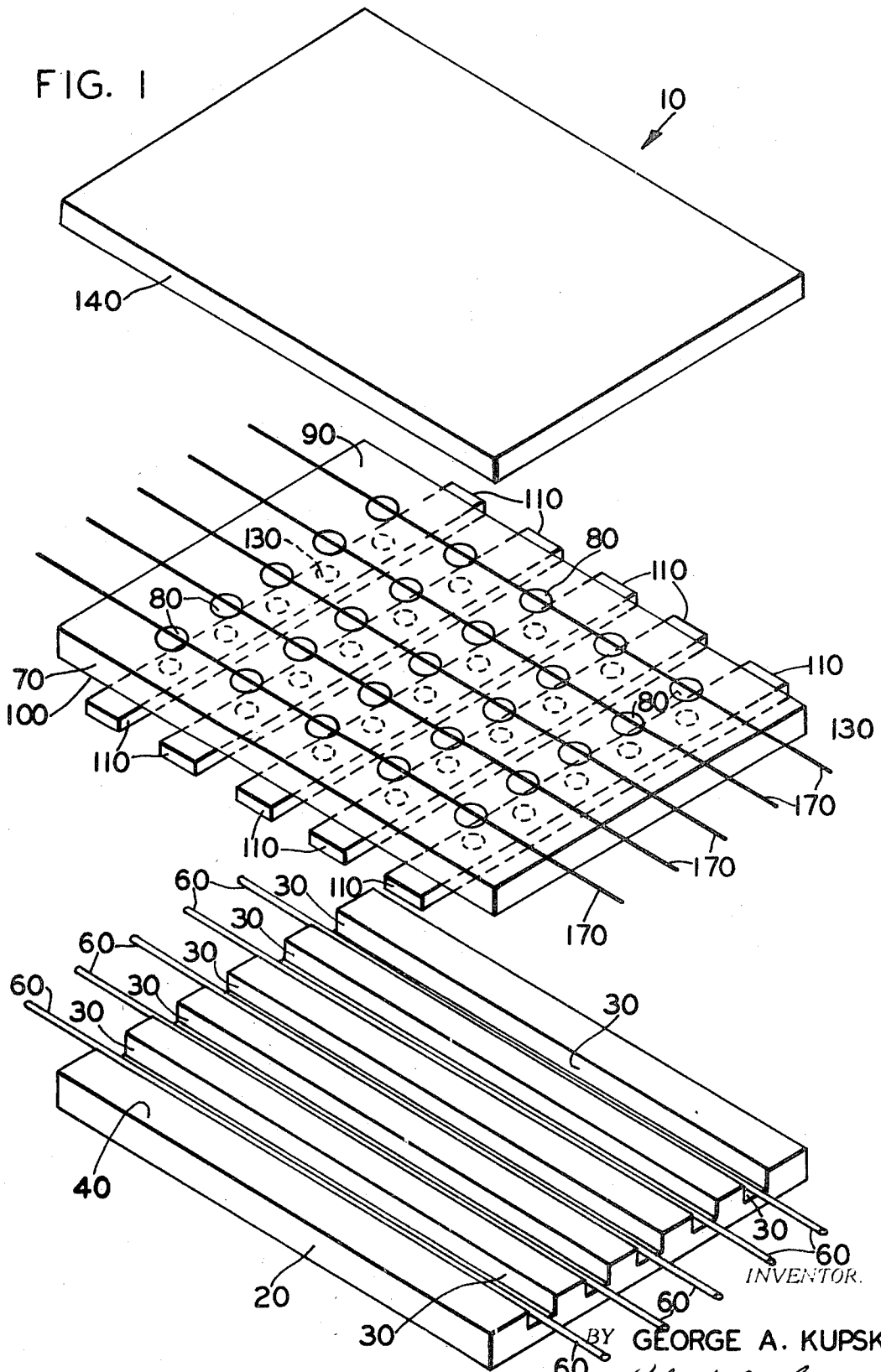


FIG. 1



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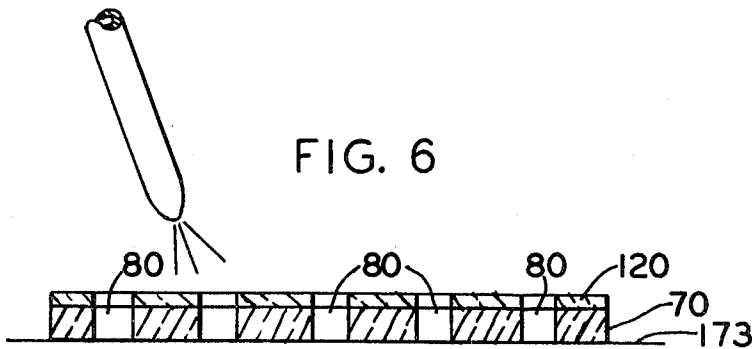
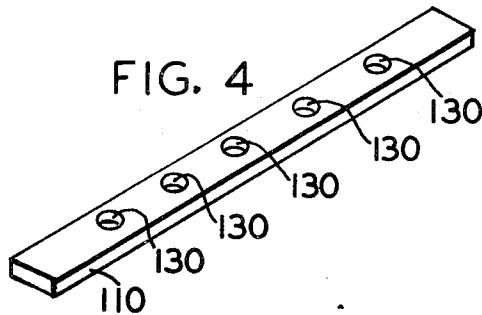
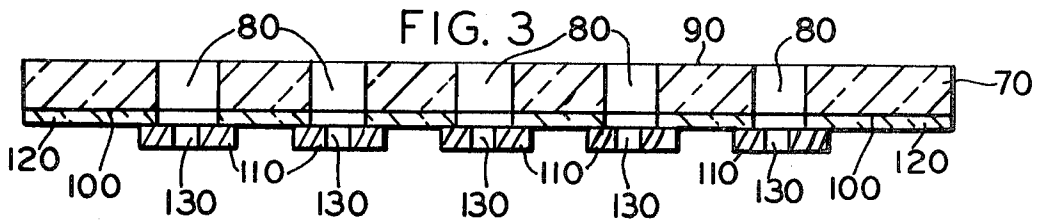
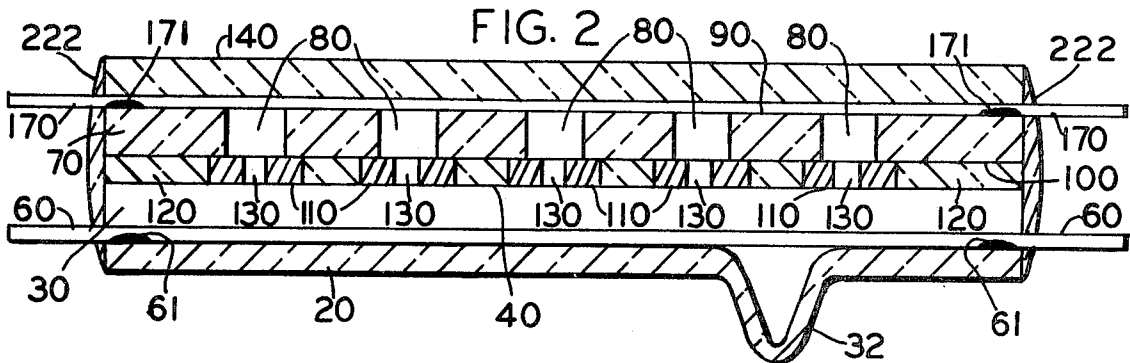
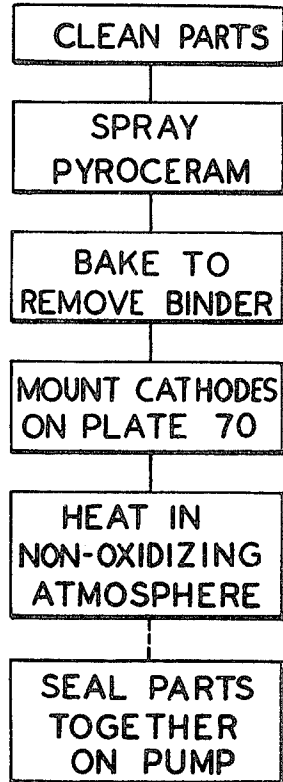


FIG. 5



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FIG. 7

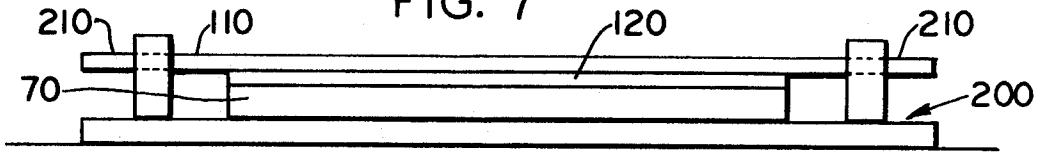
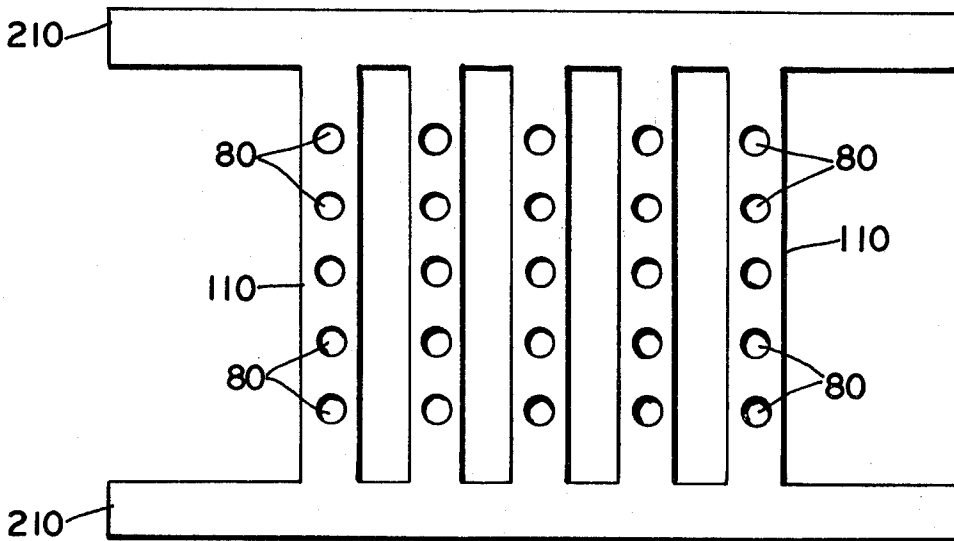


FIG. 8



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GASEOUS DISPLAY PANEL HAVING TWO ARRAYS OF GAS CELLS

BACKGROUND OF THE INVENTION

Applicant has recently developed a display panel which includes a plurality of insulating plates and a plurality of arrays of electrodes. All of which must be carefully processed and assembled to achieve satisfactory operation. In particular, the glow cathodes must be kept as clean as possible to achieve uniform firing at a favorably low-firing potential. Display panels of this type are new to the art and, consequently, many problems arise for which the prior art provides no solution. One problem area relates, as noted above, to processing and assembly procedures, and there is a constant need to develop processes which simplify handling and which also improve the end product, in particular, the cathode electrodes thereof.

SUMMARY OF THE INVENTION

Briefly, a display embodying the invention includes a unique arrangement of parts which permits improved assembly procedures and electrode processing.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective exploded view of apparatus embodying the invention;

FIG. 2 is a sectional view through the panel of FIG. 1 as it appears assembled;

FIG. 3 is a sectional view of a portion of the panel of FIG. 1;

FIG. 4 is a perspective view of a single cathode electrode used in the panel of the invention;

FIG. 5 is a flow chart of the method of the invention;

FIG. 6 is a sectional view showing a portion of the panel of the invention as it is being sprayed;

FIG. 7 is a sectional elevational view showing another portion of the panel as it is being assembled; and

FIG. 8 is a plan view of a cathode array used in processing the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It is to be understood that the display panel described herein may have substantially any desired size and shape, and it may include substantially any number of gas cells. The panel may also contain any suitable ionizable gas such as neon, argon, xenon, etc., singly or in combination and including a vapor of a metal such as mercury to minimize cathode sputtering.

Referring to FIGS. 1 and 2, a display panel 10 embodying the invention includes a first-insulating baseplate 20 of glass, ceramic, or the like having a plurality of parallel slots or channels 30 formed in the top surface 40 thereof. The slots 30 may have any suitable cross section, and, for purposes of description, they are considered to be oriented horizontally. A tubulation 32 is secured to plate 20 (FIG. 2).

Electrodes 60, preferably wires used as scanning anodes in one mode of operation, are seated in slots 30 and are oriented horizontally. The electrodes 60 may be secured in the slots 30 by means of a glass frit 61 or the like secured to them at the ends of the slots or at any suitable location.

The panel 10 also includes an insulating plate 70 having a plurality of apertures of cells 80 arrayed in rows and columns. Plate 70 may also be of glass; however, Forsterite is used generally at the present time. The plate (FIG. 3) includes a top surface 90 and a bottom surface 100, and an array of electrode strips 110, known as scanning cathodes, are secured to the bottom surface of the plate 70 by means of a thin layer 120 of insulating material such as glass. The electrode strips 110 are of any suitable metal such as stainless steel or the like, and they are oriented vertically at 90° to the wire electrodes 60. Each cathode includes a series of apertures 130 of about 1 to 3 mils in diameter (FIG. 4) which are generally aligned with a column of cells 80 in the plate 70. The plate 70 is positioned on the bottom plate 20, with the rows of apertures 130 aligned with the slots 30 in the bottom plate and with the cathode

strips 110 each having an aperture 130 overlying a portion of a wire 60 beneath it. Thus, the columns of aperture 130 are aligned with columns of cells 80, and the rows of apertures 130, formed by adjacent cathodes, are aligned with rows of cells 80.

The panel is completed by a glass cover plate 140 which is seated on plate 70 with an array of wire electrodes 170 disposed between top plate 140 and the centerplate 70. The wire electrodes 170 may be secured either to the bottom surface of the top plate or to the top surface of the bottom plate by means of small quantities of glass frit 171 or the like disposed near the edges of the plates (FIG. 2). Wires 170 might also be seated in depressions (not shown) in plate 140 or plate 70. The electrode wires 170 are oriented horizontally, each being directly above one of the wires 60 in the bottom plate, whereby each is aligned with a row of cells 80 in the centerplate and with a row of apertures 130 in the adjacent cathodes 110.

According to the invention and referring to the flow chart of FIG. 5, all of the parts are cleaned and processed preliminarily as required. In particular, the cathode electrodes 110 are processed to clean the surfaces and remove all oxides. Next, the bottom surface 100 of the centerplate 70 is coated, preferably by spraying, with a thin layer of a glass frit mixture such as Pyroceram to form the insulating layer 120. The sprayed layer 120 is preferably of the order of 3 to 5 mils in thickness. The spray material comprises a finely ground glass powder in a suitable binder such as nitrocellulose and a suitable thinner such as amyl acetate added to give the mix a suitable consistency for spraying. The apertured plate 70 is held on a flat surface 173 (FIG. 6) during the spraying operation to prevent the holes 80 from becoming filled with the spray material. Since the air which forms the carrier of the spray cannot enter the holes 80, the holes are usually not filled with the spray material during the spraying process. If some holes are filled, this can be detected easily by visual observation, and the holes can be easily cleared.

Next, the coated plate 70 is baked at a suitable temperature, of the order of 380°C., to remove the binder from coating 120, and then the cleaned cathode electrodes are placed on the coated surface 120 of plate 70, each aligned with a column of cells and with the apertures 130 aligned with holes or cells 80. The cathodes and plate 70 may be held together in any suitable type of jig, as illustrated at 200 in FIG. 7. For convenience, the cathodes are provided in a unitary array in which they are secured at their ends to bus bars 210, by which they can be easily held in place on the jig. The cathode array shown in FIG. 8 can be prepared by a photoetching process, as is well known in the art. In the completed panel, bus bars 210 are removed to separate the cathodes from each other. The plate 70 carrying the cathodes 110 is then baked at a temperature of about 485°C. in a nonoxidizing atmosphere such as nitrogen, to cause the glass frit to fuse and thus provide an intimate bond between the electrode array and the glass coating when the parts are cooled. During this operation, the nonoxidizing atmosphere prevents oxidation of the cathode electrodes.

The panel is then assembled in relatively simple fashion in a suitable jig (not shown) by forming a sandwich of the bottom plate 20, its wire electrodes 60, the centerplate 70 and its electrodes 110, and electrodes 170, and finally top plate 140. A layer 222 of Pyroceram is placed along the periphery of the panel overlaying the adjacent edges of the various plates. The assembly is then placed in an oven with the panel tubulation 32 suitably coupled to a manifold which can be connected to a vacuum pump and to a source of the desired gas with which the panel is finally filled. With the tubulation 32 connected to vacuum, the panel is bake to remove impurities as is well known, and to fuse the Pyroceram layer which, on subsequent cooling, forms a hermetic seal between the various plates and electrodes. After the seal 222 has been formed, the panel is filled with the desired gas and processed to completion.

A display panel embodying the invention has an important advantage in that its electrodes, particularly its cathodes, can

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be kept clean and unoxidized. In addition, the preparation of the electrode plate subassembly permits an overall reduction in assembly time and an improvement in the quality of the panel, due to the fact that, in the subassembly, the electrodes are accurately positioned and secured, and they are later accurately assembled with the other panel parts.

Many different materials may be used in practicing the invention, and generally, materials are selected for their ability to be coupled together. Usually, the top and bottom plates are of glass, and the centerplate is a material such as Forsterite. The electrodes may be of stainless steel or the like with Sylvania Alloy No. 4, alloy of chromium, iron, and nickel, being commonly used.

What is claimed is:

1. A display panel comprising

a gas-filled envelope including a bottom plate, a centerplate, and a top plate, all of dielectric material, said bottom plate having a top surface in which a plurality of first parallel slots are formed and in each of which a first electrode is seated, said centerplate having a top surface and a bottom surface and a plurality of holes arrayed in rows and columns and filled with said gas, a thin insulating glass coating covering said bottom surface of said centerplate but not obstructing said holes,

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a plurality of second electrodes secured to said insulation coating and each having portions overlying said holes in said centerplate and in contact with the gas therein, said second electrodes being oriented at an angle to each said first electrode whereby each second electrode crosses each first electrode and each crossing defines a first gas cell,

said centerplate being positioned so that the rows of holes therein are aligned with said slots in said first plate, and a plurality of third electrodes positioned between said centerplate and said top plate, each being in operative relation with a plurality of holes in said centerplate, said third electrodes being disposed parallel to said first electrodes and thus crossing each of said second electrodes, each crossing being at a hole in said centerplate and defining a second gas cell therewith, there thus being an array of first gas cells and an array of second gas cells, each first cell communicating with one of said second cells.

2. The panel defined in claim 1 wherein said second electrodes comprise metal strips, each having a series of holes aligned with a column of said holes in said centerplate.

3. The panel defined in claim 1 wherein said insulating coating comprises a fused powdered glass.

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