United States Patent [19]

Van Esdonk et al.

[11] **3,776,613**

[45] **Dec. 4, 1973**

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

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[21] Appl. No.: **285,477**

Related U.S. Application Data

[62] Division of Ser. No. 120,103, March 2, 1971, abandoned.

[30] **Foreign Application Priority Data**

Mar. 20, 1970 Netherlands 7003971

[52] **U.S. Cl.** **316/20,** 156/3, 313/220

[51] **Int. Cl.** **H01j 9/38**

[58] **Field of Search** ..... 29/25.13, 624, 625; 316/17, 19, 20, 24; 156/1, 2, 3, 6, 7, 14, 24; 315/169 R, 169 TV; 313/109.5, 220, 201, 210, 217; 117/212

[56] **References Cited**

UNITED STATES PATENTS

3,617,796 11/1971 Caras 313/220

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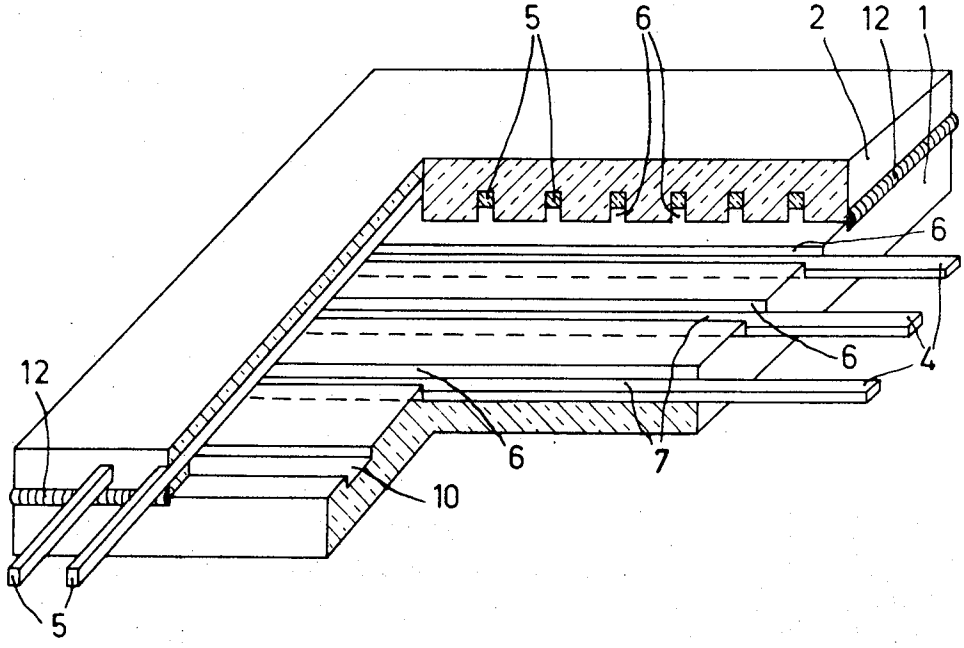
[57] **ABSTRACT**

A method of making a gas-discharge panel comprising etching discharge cavities and interconnecting channels between the discharge cavities out of strip-shaped electrodes embedded in insulating plates. The channels are etched beneath the surface of the insulating plate to depths which do not allow a discharge in one cavity to strike a discharge in adjacent cavities.

2 Claims, 3 Drawing Figures



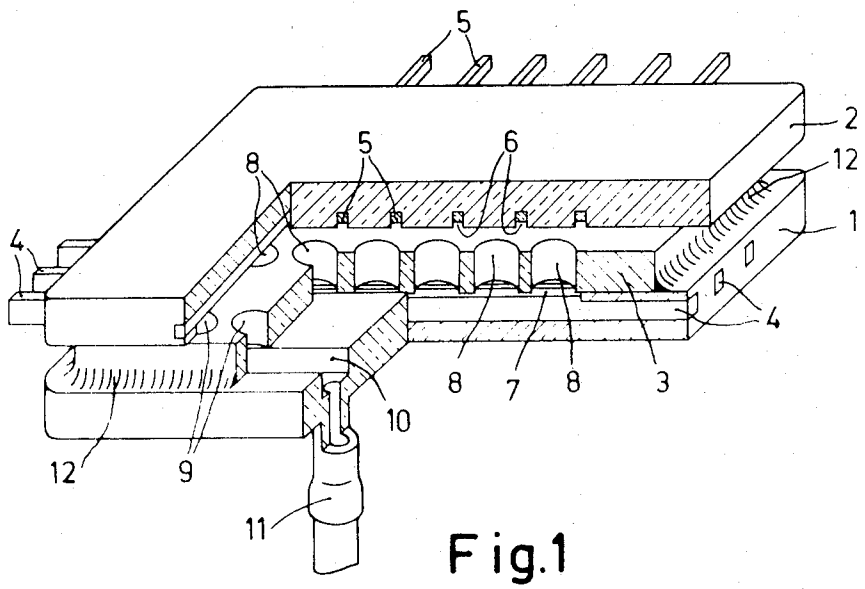


Fig.1

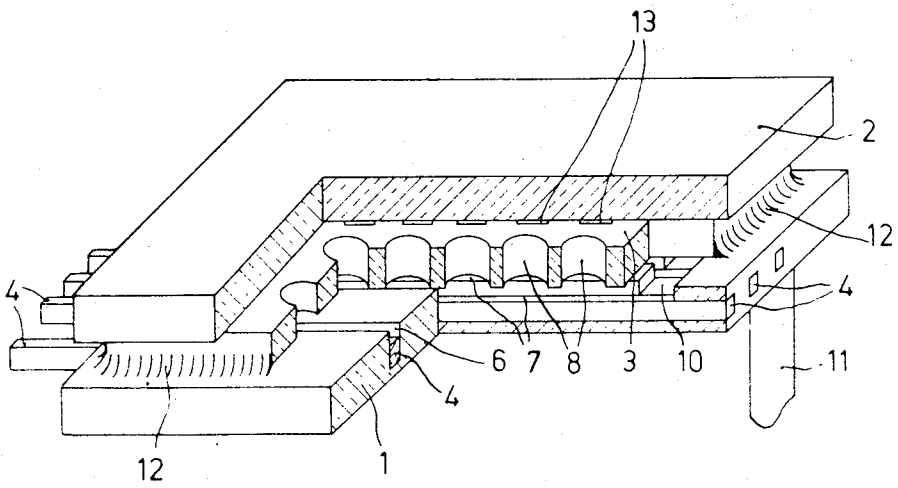


Fig.2

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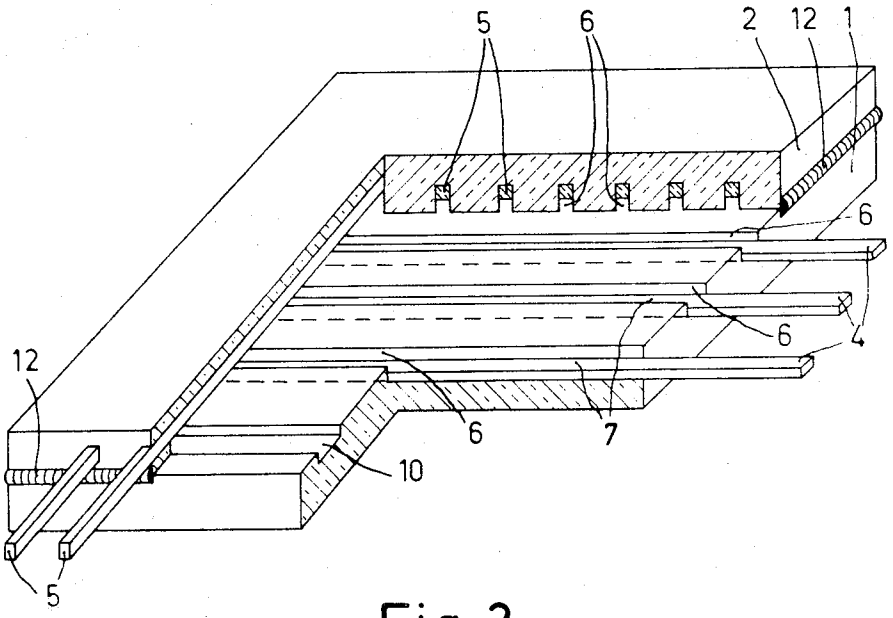

Fig. 3

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GAS-DISCHARGE DISPLAY PANEL

This is a division of application Ser. No. 120,103, filed Mar. 2, 1971, now abandoned.

The invention relates to a gas-discharge display panel comprising at least one top plate of insulating material transparent to light and one bottom plate, in which the top plate and/or the bottom plate are provided with a plurality of strip-shaped, relatively insulated electrodes embedded in the insulating material, while between the conductors of the bottom and top plates a plurality of cavities are provided in which gas discharges can occur upon the application of suitable potential differences between the electrodes.

The cavities may alternatively be formed by the holes of a perforated intermediate plate, which may be arranged between the bottom and top plates.

In such panels the cavities have to communicate via channels with a common channel connected with a pump tubing in order to permit of evacuating and supplying the gas for the gas discharges.

From U.S. Pat. No. 3,334,269, FIG. 5, it is known to arrange such channels in the intermediate plate, which is, however, an elaborate operation, particularly in the case of panels of large size.

A simple method is obtained by establishing the communication between the gas discharge cavities and the common channel by etching away strip-shaped electrodes of the bottom and/or top plates at least over part of their length to beneath the surface of bottom or top plate facing the discharge cavities. Thus communication channels of the cavities located opposite said conductors are made with the common channel. Etching can be carried out in a simple manner simultaneously for all conductors of bottom or top plate, in contrast to an individual, mechanical arrangement of a great number of communication channels in the known embodiment.

The invention will be described more fully with reference to the drawing, in which

FIG. 1 is a perspective view of a partial section of a given embodiment of a display panel and

FIGS. 2 and 3 show similar sectional views of other embodiments of a panel in accordance with the invention.

Referring now to FIG. 1, reference numeral 1 designates an insulating bottom plate, 2 a top plate of transparent, insulating material and 3 a perforated intermediate plate.

In the bottom plate 1 are embedded a plurality of parallel, strip-shaped conductors 4, the surface 7 of which is level with the surface of the bottom plate 1 and is therefore in contact with the gas contained in the cavities 8 formed by the holes of the sandwich plate 3. The parallel conductors 5 are embedded in the top plate 2. The surface of the conductors 5, which serves as a electrode, is etched away so that it is located below the surface of the top plate 2 facing the discharge cavities in the intermediate plate 3. Thus channels 6 are formed between the active surfaces of the electrodes 5 and the surface of the sandwich plate 3, which channels link the discharge cavities 8 of the sandwich plate 3 located beneath the conductors 5 to each other. Each channel opens out in an opening 9 near the edge of the plate 3. The openings 9 communicate with a common channel 10 in the bottom plate 1. The channel 10 communicates with the pump tubing 11. After the plates are connected with each other in a vacuum-tight manner for example, by means of a sealing substance 12, a readily melting kind of glass or an appropriate synthetic resin, it is thus possible to exhaust all cavities 8 via the openings 9 and the channel 10 and to fill them with an appropriate gas.

Since the channels 6 have a small height, for example, of 50 μ which is shorter than the free stretch of path of the electrons in the gas, a discharge in a given cavity 8 cannot leap to the adjacent cavities.

Embedding of the conductors 4 and 5 in the insulating plates 1 and 2 respectively can be carried out in a simple manner by arranging the strip-shaped conductors in a jig, by filling the spaces left with the insulating material, for example, in the powdery state, and by heating the assembly until the insulating material melts. When glass is used as an insulating material heated conductors may, as an alternative, be pressed into the glass softened by heat. Then the bottom plate 1 or the top plate 2 or, if desired, both can be simply put in an etching bath, after the metal surfaces not to be etched have been covered, so that the conductors are partly etched away and the grooves 6 are formed, which form the channels 6 when the panel is mounted.

The perforated plate 3 may be formed by an aluminium sheet provided with holes, for example, by drilling and subsequently oxidized by electric agency so that the sheet is coated with an insulating alumina layer.

In FIG. 2 the strip-shaped conductors 5 are replaced by conductive metal layers 13. In this case the channels 6 are obtained by etching away part of the conductors 4. The conductive layers 13 may be transparent to light.

If the conductors of the bottom and/or top plates are etched to a depth such that at the crossings between the conductors of the bottom and top plates cavities are formed, which may serve as discharge cavities, the elaborate, perforated intermediate plate may be dispensed with, as is shown in FIG. 3.

What is claimed is:

1. A method of making a gas discharge panel, comprising forming insulated plates having embedded therein strip-shaped electrodes proximate to surfaces of said insulated plates, at least one of said plates being of transparent insulating material, etching the strip-shaped electrodes of said insulated plates to form grooves on the surfaces of said insulated plates, placing the grooved surfaces of said insulating plates together in a confronting relationship so that the strip-shaped electrodes of one plate orthogonally face the strip-shaped electrodes of the other thereby forming discharge cavities having interconnecting channels between the confronting surfaces of said insulating plates, hermetically sealing said insulating plates and evacuating and filling the discharge cavities and interconnecting channels with ionizable gases.

2. A method as claimed in claim 1 wherein etching the strip-shaped electrodes comprises removing material to a depth less than the free path of the electrons in the gas contained in the discharge cavities and interconnecting channels.

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