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[54] **PILOT LIGHT GAS CELLS FOR GAS PANELS**
3 Claims, 2 Drawing Figs.

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313/108 B, 313/197, 315/169 R
 [51] Int. Cl. **H01j 1/00,**
H01j 7/30
 [50] Field of Search **178/7.3 D,**
7.5 D; 313/109, 108 B, 208, 210, 197; 315/169,
169 T, 169 TV, 249; 340/373, 378, 324 A, 343,
344, 166 R

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3,559,190 1/1971 Bitzer et al. 340/173

ABSTRACT: In a plasma display panel consisting of gas enclosed between adjacent insulating members, a light source in the panel is used to supply a number of uniformly spaced charged particles in the gas to permit firing of the gas when coordinate conductors identifying a site location are energized. The light source may comprise in a preferred embodiment one or more critically placed pilot lamps or auxiliary conductors in the display matrix which are constantly energized or a plurality of light sources positioned adjacent display areas. The use of such pilot lamps facilitates cell selection and firing, with uniform selection and firing potentials within all sites of the display panel.

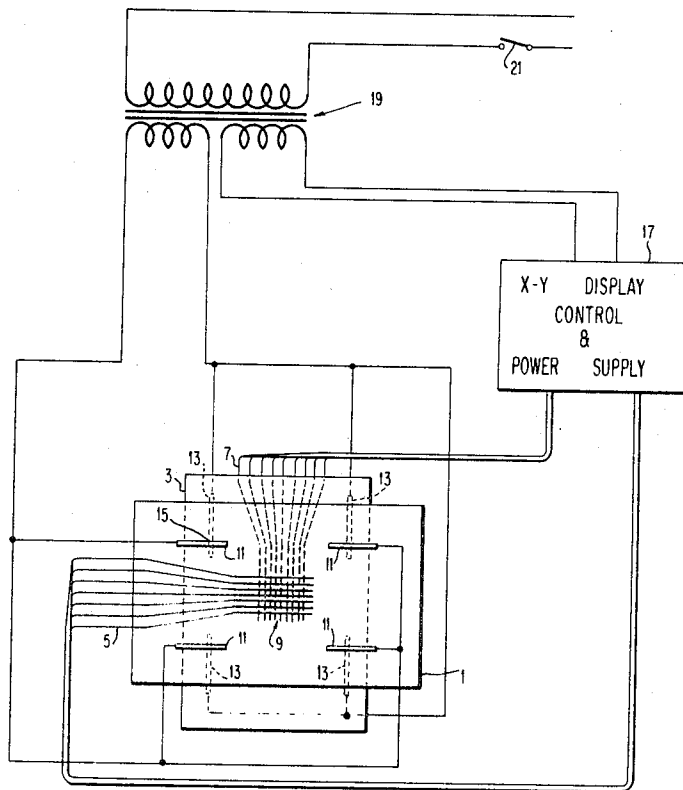


FIG. 1

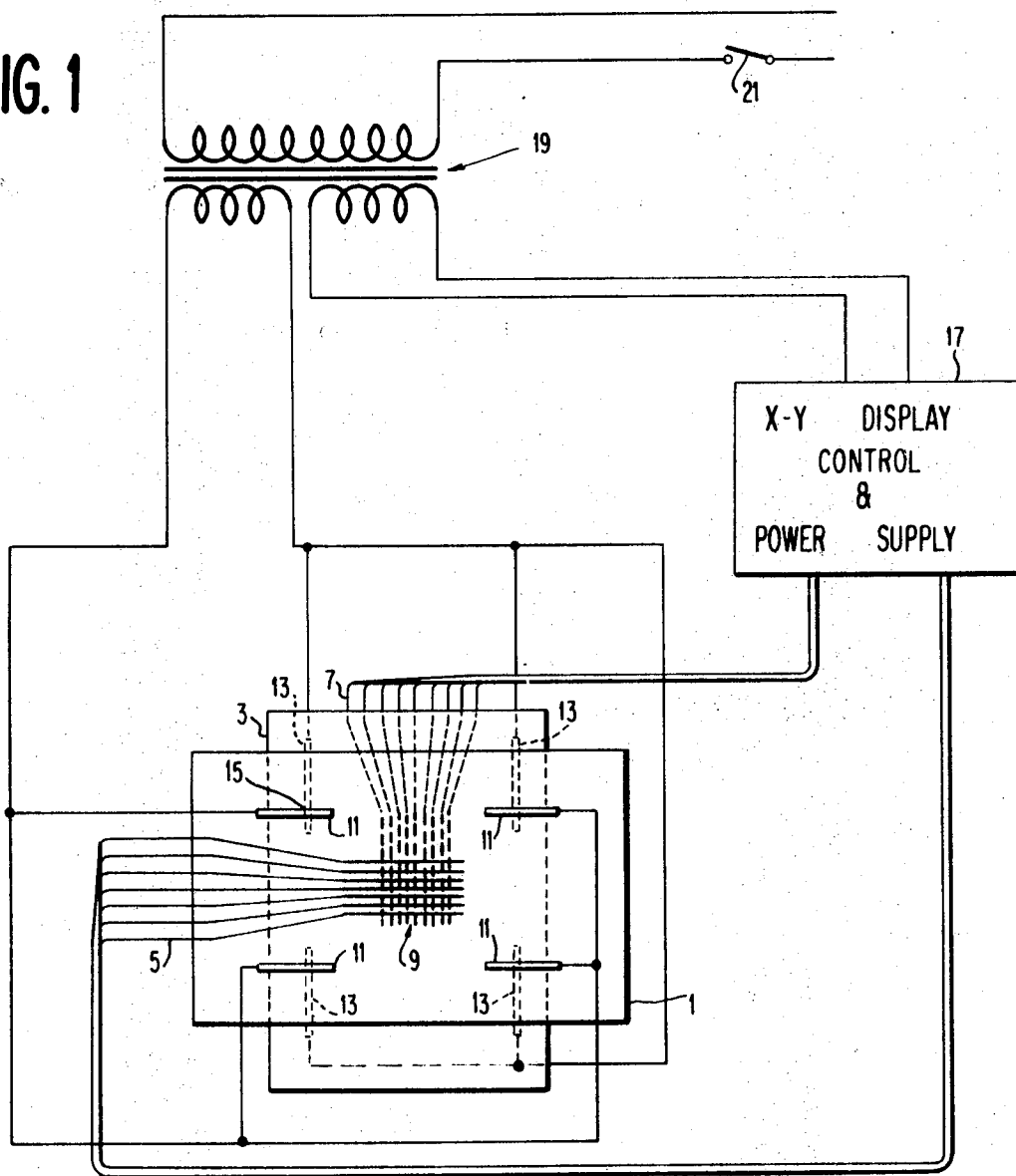
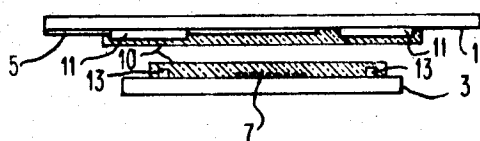


FIG. 2



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PILOT LIGHT GAS CELLS FOR GAS PANELS

CROSS REFERENCE TO RELATED APPLICATIONS

Application Ser. No. 785,172 (IBM Docket Ki967025), filed Dec. 19, 1968 for "Display System" by James C. Greeson, Jr. et al.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to display devices and their systems and more particularly to an improved plasma display device.

2. Description of the Prior Art

Plasma display devices comprising a matrix of spaced electrode pairs and having disposed between these electrode pairs a gaseous element are known in the art. Two variations of plasma display panels have been described in "The Plasma Display Panel—A Digitally Addressable Display With Inherent memory," published in the Proceedings of the Fall Joint Computer Conference, 1966, and "Flat Display Has Inherent Memory" published in Electronics, Mar. 31, 1969, pages 133—136. Such gas panels are composed of a container filled with gas which may be selectively illuminated by an ignition or firing potential applied thereacross. X-drive lines in the form of a grid pattern are disposed on one side of the panel with Y-drive lines in the form of a grid located on the opposite side of the panel, the X- and Y-drive lines being orthogonally disposed. The crossover regions of the X- and Y-drive lines define coordinate intersections, sometimes designated electrode pairs, and the gas between the drive lines in such regions of the gas panel constitutes gas cells or sites which may be selectively ignited by electrical firing potentials on selected X- and Y-drive lines to generate numbers, characters and the like on the display panel. The voltages applied to the X- and Y-drive lines are slightly greater than one-half the voltage necessary to initiate a discharge on a selected site. Once ignited, a cell is maintained in panel illumination state by a lower potential sustain signal until erased. Erasure is accomplished by two rapid reversals of state of signals applied to the specified cell or site. Such display panels operate on the theory of cell wall charge in which oppositely charged particles are attracted to respective cell walls, the voltage resulting from the wall charge condition being such as to oppose the applied signal. In addition to the firing potential impressed across selected electrodes, therefore, a sufficient number of charged particles must be initially available in the gas in order for a discharge to be initiated and completed with minimal delay. Assuming that there is an insufficient number of charged particles in the volume, selected cells or sites will not fire when a firing potential is applied across their coordinate conductors, or alternatively, firing of selected cells will require a large and variable number of starting pulses to be applied prior to ignition. If a sufficiently high voltage was applied to overcome the absence of charged particles, it might exceed the breakdown potential of the insulator or the device itself. It is to the objective of providing a source of charged particles to all the cells or sites in a plasma display panel to provide positive cell discharge with uniform potentials in all areas of the panel and to assist in write, sustain and erase operations to which the present invention is directed.

SUMMARY OF THE INVENTION

To provide a source of charged particles, the present invention employs a light source incident to the panel for the purpose of establishing a source of metastables, electrons, and ions to permit uniform cell ignition within sites of the panel itself. Such light source may take the form of a lamp or lamps so disposed within the panel as to create a source of metastables, at all sites within the panel. The preferred embodiment of the present invention utilizes auxiliary pairs of electrodes having an independent power supply which when discharged provides and maintains the light source. Alternatively, individual character display locations might have a single coordinate intersection ignited, or a controlled display symbol such as a

cursor might be employed adjacent to the location for displaying incoming information. By providing gas discharge to provide a source of metastables distributed throughout the panel in the manner above described, positive firing of selected cells at uniform potentials from cell to cell can be achieved.

Therefore, it is an object of this invention to provide positive firing potential of selected cells or sites in a gas panel matrix.

It is a further object of this invention to create a uniform firing condition at all coordinate intersections in a gas panel matrix by providing a source of charged particles.

Lastly, it is an object of this invention to insure positive discharge in a gas display panel by providing a source of charged particles throughout the gas from a light source within the panel itself.

The objects of this invention are met by the creation of a uniform flux of electrons, ions, and metastable atoms between all electrode pairs. The flux is created in the preferred embodiment by a plurality of critically placed continuously discharging electrode pairs. Further, in the preferred embodiment these electrodes are differently shaped and are powered from a different electrical source than the electrode pairs forming the actual display matrix.

In particular, the preferred embodiment of the invention is a gas panel formed by a plurality of "printed-on" parallel electrodes on two insulating members, these insulating members being sandwiched together with their respective electrodes perpendicular to each other. A gaseous element forming the discharge media is disposed between the two insulated members. The electrodes in the preferred embodiment are on the inside of the insulating member but suitably insulated from direct contact with the gaseous element. In addition to these normal matrix electrodes, the preferred embodiment includes a plurality of electrodes on each insulating member which pair with electrodes on the other insulating member. These electrode pairs serve as "pilot" electrode pairs. These pilot electrode pairs in the preferred embodiment are continuously energized by a source of alternating current independent of the alternating current source which activates the electrode pairs forming the display matrix. These pilot electrode pairs are critically located to produce a uniform flux of electrons, ions, and metastable atoms located between the electrode pairs of the display matrix. As one skilled in the art can readily see, these electrons, ions, etc. will flow from the pilot electrode discharges to the other electrode pairs of the display matrix so as to produce a steady state condition of charged particles between the electrode pairs of the display matrix.

Further, the electrodes forming the pilot electrode pairs in the preferred embodiment are wider than the electrodes comprising the display electrodes to produce a higher charge particle output.

Since the insulating members are transparent in order that the gaseous discharges may be seen, it is important in the preferred embodiment that the pilot electrode pairs be hidden from view. In the preferred embodiment this is accomplished by making the areas in which the pilot light source is located opaque.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention as illustrated in the accompanying drawings:

FIG. 1 is a top view diagrammatically illustrating of the preferred embodiment of the invention.

FIG. 2 is a side view of the invention shown in FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the figures, there is seen an illustration of a preferred embodiment according to the subject invention. Transparent insulating members 1 and 3 comprising opposite sides of a glass container have printed on them parallel

orthogonal drive lines 5 and 7, respectively. Insulating members 1 and 3 are sandwiched together such that parallel grids 5 and 7 lie perpendicular to each other resulting in intersecting cells or sites 9. For purposes of clarity, the preferred embodiment is shown as comprising a 7×9 matrix of cells formed by 7 parallel electrodes on one insulating member and 9 parallel orthogonal electrodes on the other insulating member.

In addition to the above electrodes printed onto insulating member 1 are electrodes 11 and printed onto insulating member 3 are electrodes 13. Electrodes 11 and 13 designated pilot lamp electrodes intersect so as to form electrode pairs exemplified by reference numeral 15. In the preferred embodiment, there are four sets of intersecting electrodes 11 and 13, each of electrodes 11 and 13 being wider than drive lines 5 and 7. These electrode pairs form the pilot electrode pairs or cells 15. The insulating members 1 and 3 in the preferred embodiment are opaque above electrode pairs 15. Each of these electrode pairs are positioned as closely as possible to the electrode pairs 9 which form the matrix display to provide a uniform source of charged particles throughout the panel. Other arrangements wherein the pilot lamps are positioned within the outer fringes of the panel but beyond the display area could be employed. In the preferred embodiment, there are four electrode pairs 15 and they are located at the corners of the matrix display 9. However, the number and size of lamps required is a function of the size and intensity of the individual lamps and a greater or lesser number may be employed to enhance the efficiency of the gas discharge panel.

As previously indicated, a gaseous mixture is disposed between the two insulating members 1 and 3. The gas may be an inert gas such as Neon, Argon, or the like, or it may include a mixture of such gases or a mixture of inert and other gases. One suitable mixture may include 90 percent Neon and 10 percent Nitrogen, although different combinations of other gases in varying proportions may be suitably employed. Parallel drive lines 5 and 7 are connected to the X-Y Display Control and Power Supply 17 so that an appropriate alternating signal can be applied to selected coordinate intersections 9. While various methods may be employed to drive the gas panel, a preferred method is shown and described in detail in the aforementioned copending application Ser. No. 785,172.

The pilot electrode pairs 15 are connected to opposite windings of power transformer 19. By providing a separate power source for electrode pairs 15 and matrix 9, their relative impedances do not effect one another and the plot lamps may be maintained ignited to permit instantaneous operation of the display device. However, as previously indicated, the pilot electrodes could be driven by the same source as the display electrodes, and could in fact comprise selected orthogonal intersections 9 of the display matrix.

In the primary winding circuit of power transformer 19 there is a power switch 21. This power switch 21 controls the energization of power transformer 19 in the well-known manner.

OPERATION OF INVENTION

Immediately upon closing of power switch 21, power transformer 19 becomes energized. Thereafter, each of the pilot electrode pairs 15 discharges. That is, the secondary power transformer winding associated with pilot electrode pairs 15 is such that the voltage impressed across each of the pilot electrode pairs causes those pilot electrode pairs to discharge. The discharge associated with each of the pilot electrode pairs causes a flux of electrons, ions, and metastable atoms to flow through the display matrix 9. Extremely rapidly a steady state is reached where a given amount of electrons, ions, and metastables are contained and relatively uniformly distributed within the gas sandwich between insulator members 1 and 3. This flux of electrons, ions, and metastables has been found to produce positive ignition of selected display sites by providing the necessary charge particles, and additionally may cause a lowering of the firing potential necessary to cause a discharge

in the cells or sites formed by electrode sets 5 and 7 and cause the firing potential associated with different cells or sites to be substantially uniform.

The electrode pairs formed by electrode sets 5 and 7 are fired through X-Y display control and power supply 17 in a well-known manner such as that shown in the above referenced copending application Ser. No. 785,172. Either through computer control or manual operation or some other well-known method (none of these are shown or considered necessary for an understanding of the subject invention), slightly greater than one-half inch the firing potential of different polarities is impressed on each of the two electrodes associated with a given intersecting point in display matrix 9. At the point where these two electrodes intersect, the applied voltages add such that the potential difference between the two electrodes exceeds the firing potential. This causes a discharge at this point. Only at this point will the potential differences between the two electrodes be great enough to initiate a discharge. That is, the other electrodes with which the electrodes with slightly greater than one-half the firing potential intersect either have no voltage impressed on them or the sustain voltage. Immediately after a discharge occurs at the desired point in matrix 9, X-Y display 17 lowers the potential on these two electrodes forming the electrode pair to slightly greater than one-half the sustain potential.

While the subject invention has been described in terms of a simplified embodiment for purposes of clarity, it will be appreciated in practice that much larger display matrices are contemplated, rather than a single character 9×7 matrix shown. In practice, between 40 and 100 orthogonal conductors or electrodes per inch are contemplated, varying in accordance with the desired display resolution. By providing auxiliary gas discharge devices as in the present invention, a source of metastables is achieved with minimum panel modification. The method is a significant improvement over other metastable sources such as radioactive elements, thermionic emission, cosmic rays or ultraviolet light. The pilot lamp discharge provides a source of metastables under independent control from the display to permit positive firing of any display site within the panel. In addition to providing positive firing of selected cells, the subject invention enhances the erase and sustain operation of plasma displays.

While the invention has been particularly shown and described with reference to the preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A plasma display device comprising in combination:
 - a gas panel consisting of a gaseous discharge medium sealed in a flat envelope,
 - a first plurality of spaced electrical electrodes disposed on one side of said panel,
 - a second plurality of spaced electrical electrodes disposed on the opposite sides of said panel, said second plurality of electrodes being orthogonally related with respect to said first plurality of electrodes, the crossover regions of said first and second electrodes defining a matrix of coordinate intersections comprising individual display sites;
 - at least one auxiliary pair of electrodes, one of each pair disposed on one side of said panel, the other of the pair disposed on the opposite side of said panel, each said pair being orthogonally positioned with respect to each other, the electrodes of each auxiliary pair being wider than the width of the electrodes comprising the first and second plurality of electrodes;
 - means for insulating the electrodes from the discharge medium;
 - a source of current for discharging predetermined ones of said matrix display sites in said gaseous medium, and for discharging said auxiliary electrodes to cause a constant quantity of ions, electrons, and metastable atoms to be disposed between said display sites, thereby lowering and

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uniformly determining the firing potential of said display sites when coupled to said source, the greater width of the auxiliary electrodes as compared to the width of the matrix electrodes producing a higher charge output from the auxiliary electrodes than from the matrix electrodes.

2. A gas panel display as in claim 1 wherein there are four pairs of auxiliary electrodes and each of said pairs is located at

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a corner of the matrix of the display sites.

3. A gas panel display as in claim 1 wherein said source of alternating current consists of two independent sources of alternating current, said matrix of display sites associated with one of said sources and said auxiliary pairs of electrodes associated with the second of said sources.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,609,658 Dated September 28, 1971

Inventor(s) Parviz Soltan

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 43 After "such" delete "metasbes8" and
substitute therefor --as--.

IN THE CLAIMS

Column 4, line 71 After "of" insert --alternating--.

Column 4, line 72 After "matrix" insert --of--.

Signed and sealed this 6th day of June 1972.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents