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Brown

[11] **3,909,657**

[45] **Sept. 30, 1975**

[54] **PHOTON CONDITIONING OF GASEOUS DISCHARGE DISPLAY PANEL INCLUDING PHOSPHOR MEANS EMITTING UV RADIATION**

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[73] Assignee: **Owens-Illinois, Inc.**, Toledo, Ohio

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[21] Appl. No.: **286,016**

[52] **U.S. Cl.** **313/487**; 313/226; 313/493

[51] **Int. Cl.**[2] **H01J 61/35**; H01J 61/44

[58] **Field of Search**........ 313/188, 201, 220, 108 R, 313/109, 226, 487, 493

[56] **References Cited**

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3,499,167	3/1970	Baker et al.	313/188 X
3,513,327	5/1970	Johnson	315/169 TV X
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3,559,190	1/1971	Bitzer et al.	313/201 X
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"Optical Characteristics of Cathode Raytube Screens" — Jedec Publication, No. 16—B August 1971, pp. 10, 14, 120.

Primary Examiner—Palmer C. Demeo
Attorney, Agent, or Firm—Donald Keith Wedding

[57] **ABSTRACT**

There is disclosed the conditioning of a gaseous discharge phosphor color display device containing an ionizable gaseous medium and at least two different phosphors, each phosphor being excited by ultraviolet radiation emitted from the gaseous discharge or another source, one phosphor emitting light in the visible range for viewing of the display and another phosphor emitting radiation in the near UV non-visible range for the efficient photon conditioning of the gaseous medium without exciting the other phosphor.

11 Claims, 4 Drawing Figures

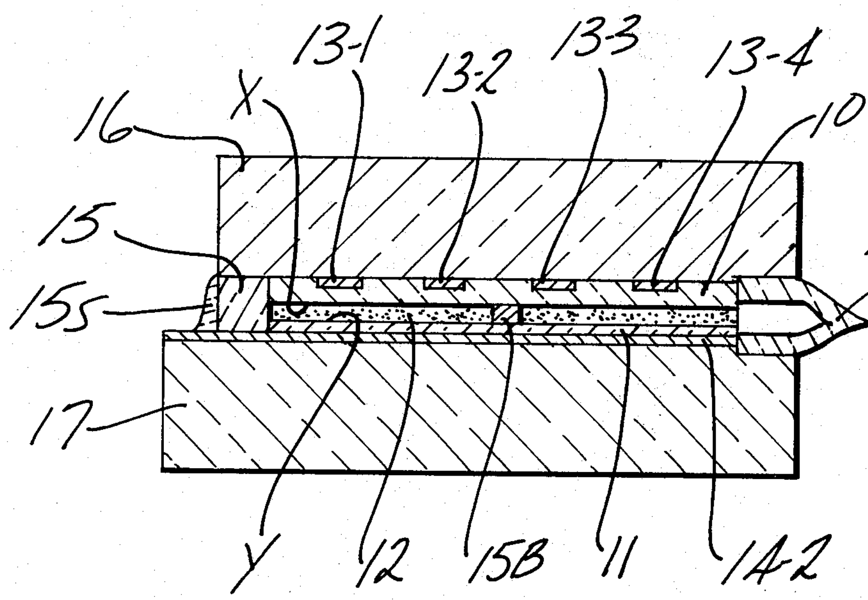


FIG. 2

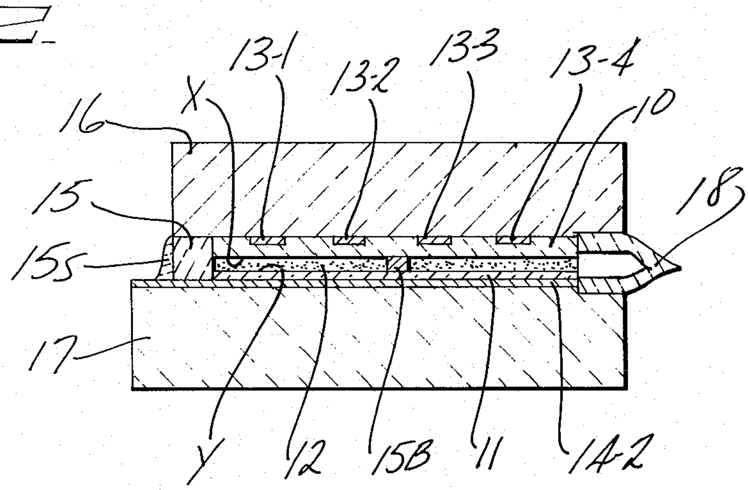
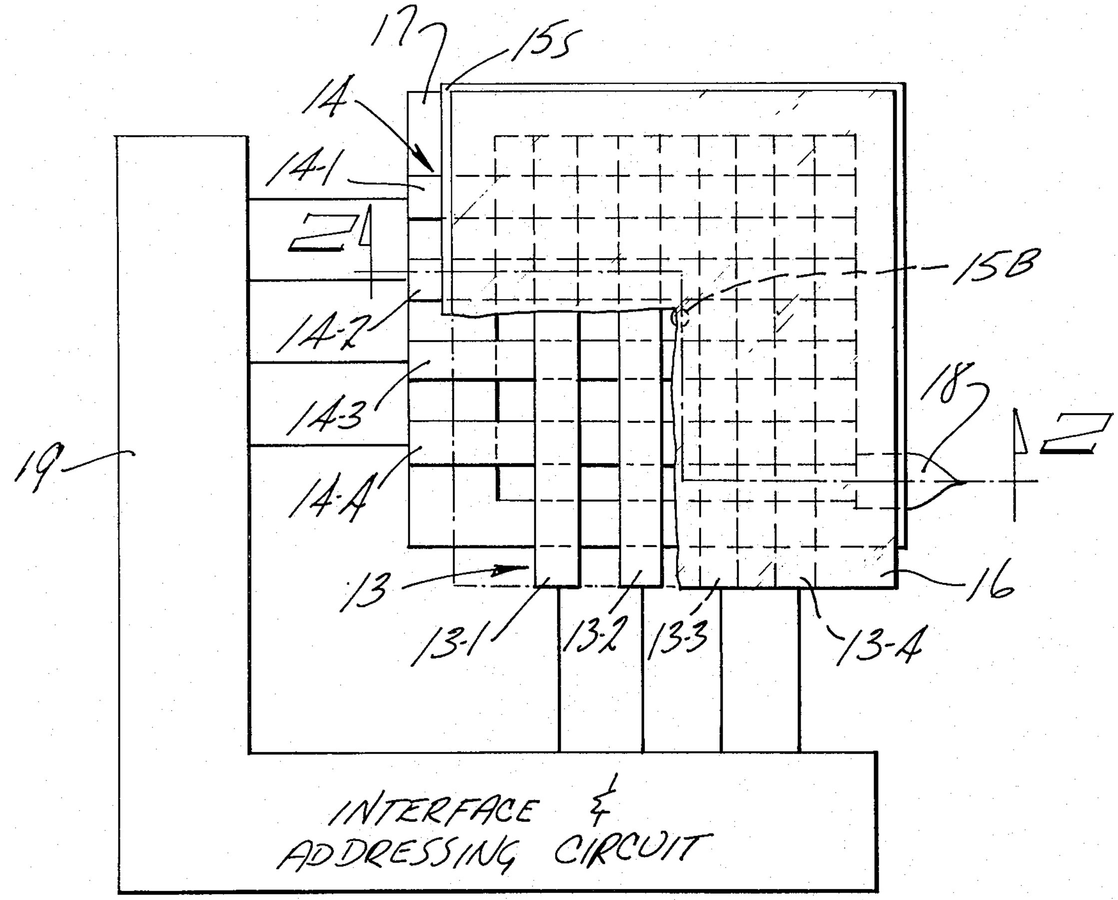

13-1
13-2
13-3
13-4
16
X
10
15
18
15S
17
Y
12
15B
11
14-2

FIG. 1


17
15S
14
14-1
2
14-2
15B
14-3
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2
19
14-A
13
13-1
13-2
13-3
13-A
16
INTERFACE & ADDRESSING CIRCUIT

FIG. 3

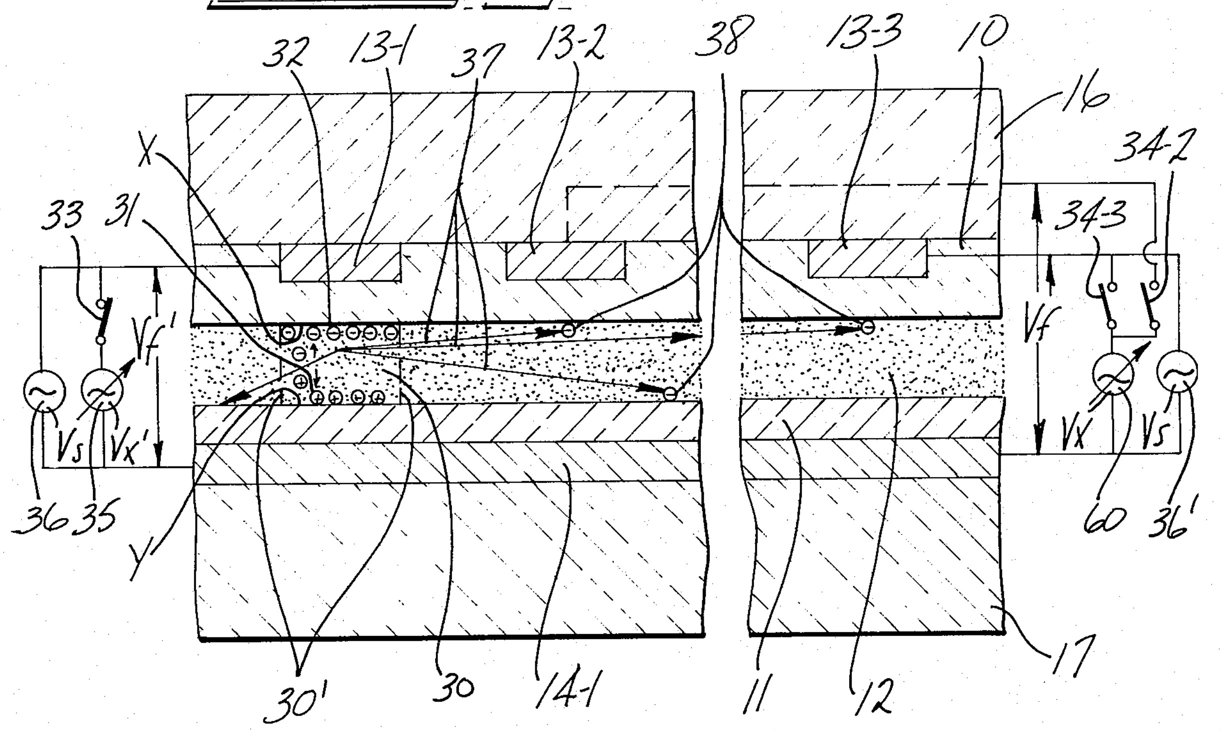
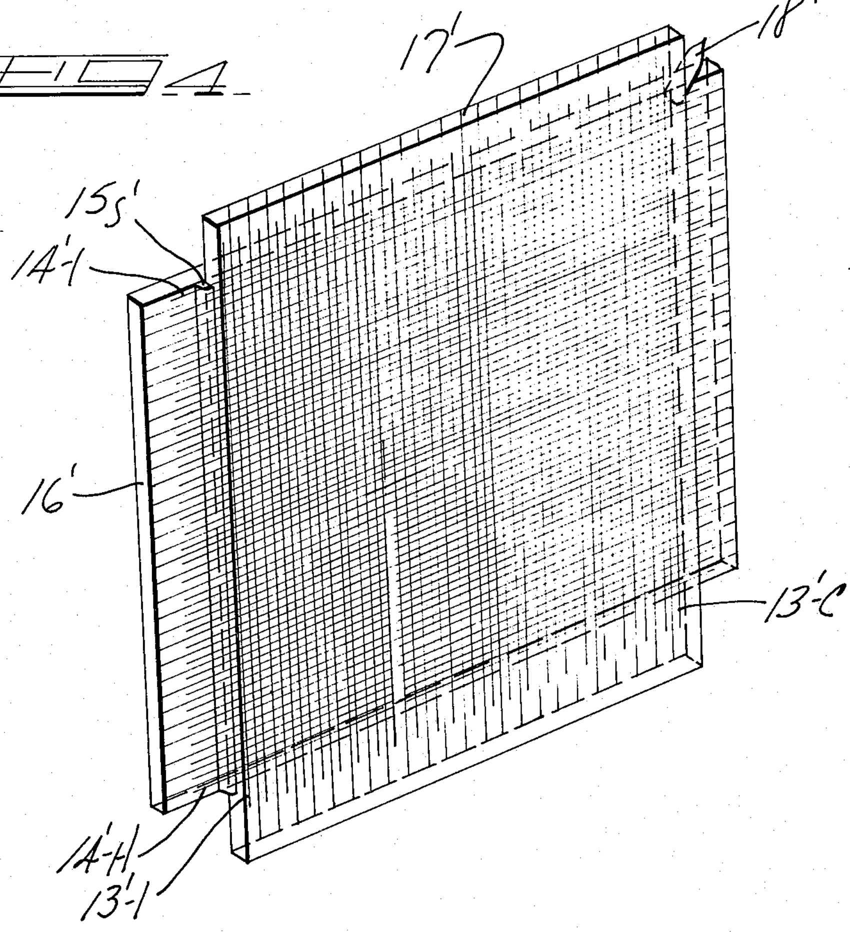

32
13-1
37
13-2
38
13-3
10
16
34-2
34-3
X
33
31
Vf'
Vf
Vs
Vx'
Vx
Vs
36
35
Y
60
36'
30'
30
14-1
11
12
17

FIG. 4


17'
18'
15s'
14'-1
16'
13'c
14'-H
13'-1

PHOTON CONDITIONING OF GASEOUS DISCHARGE DISPLAY PANEL INCLUDING PHOSPHOR MEANS EMITTING UV RADIATION

BACKGROUND OF THE INVENTION

This invention relates to gas discharge devices, especially multiple gas discharge display/memory devices which have an electrical memory and which are capable of producing a visual display or representation of data such as numerals, letters, radar displays, aircraft displays, binary words, educational displays, etc.

Multiple gas discharge display and/or memory panels of one particular type with which the present invention is concerned are characterized by an ionizable gaseous medium, usually a mixture of at least two gases at an appropriate gas pressure, in a thin gas chamber or space between a pair of opposed dielectric charge storage members which are backed by conductor (electrode) members, the conductor members backing each dielectric member typically being appropriately oriented so as to define a plurality of discrete gas discharge units or cells.

In some prior art panels the discharge cells are additionally defined by surrounding or confining physical structure such as apertures in perforated glass plates and the like so as to be physically isolated relative to other cells. In either case, with or without the confining physical structure, charges (electrons, ions) produced upon ionization of the elemental gas volume of a selected discharge cell, when proper alternating operating potentials are applied to selected conductors thereof, are collected upon the surfaces of the dielectric at specifically defined locations and constitute an electrical field opposing the electrical field which created them so as to terminate the discharge for the remainder of the half cycle and aid in the initiation of a discharge on a succeeding opposite half cycle of applied voltage, such charges as are stored constituting an electrical memory.

Thus, the dielectric layers prevent the passage of substantial conductive current from the conductor members to the gaseous medium and also serve as collecting surfaces for ionized gaseous medium charges (electrons, ions) during the alternate half cycles of the A.C. operating potentials, such charges collecting first on one elemental or discrete dielectric surface area on alternate half cycles to constitute an electrical memory.

An example of a panel structure containing non-physically isolated or open discharge cells is disclosed in U.S. Pat. No. 3,499,167 issued to Theodore C. Baker, et al.

An example of a panel containing physically isolated cells is disclosed in the article by D. L. Bitzer and H. G. Slottow entitled "The Plasma Display Panel — A Digitally Addressable Display With Inherent Memory", Proceeding of the Fall Joint Computer Conference, IEEE, San Francisco, California, November 1966, pp. 541–547. Also reference is made to U.S. Pat. No. 3,559,190.

In the construction of the panel, a continuous volume of ionizable gas is confined between a pair of dielectric surfaces backed by conductor arrays typically forming matrix elements. The cross conductor arrays may be orthogonally related (but any other configuration of conductor arrays may be used) to define a plurality of opposed pairs of charge storage areas on the surfaces of the dielectric bounding or confining the gas. Thus, for a conductor matrix having H rows and C columns the number of elemental or discrete areas will be twice the number of such elemental discharge cells.

In addition, the panel may comprise a so-called monolithic structure in which the conductor arrays are created on a single substrate and wherein two or more arrays are separated from each other and from the gaseous medium by at least one insulating member. In such a device the gas discharge takes place not between two opposing electrodes, but between two contiguous or adjacent electrodes on the same substrate; the gas being confined between the substrate and an outer retaining wall.

It is also feasible to have a gas discharge device wherein some of the conductive or electrode members are in direct contact with the gaseous medium and the remaining electrode members are appropriately insulated from such gas, i.e., at least one insulated electrode.

In addition to the matrix configuration, the conductor arrays may be shaped otherwise. Accordingly, while the preferred conductor arrangement is of the crossed grid type as discussed herein, it is likewise apparent that where a maximal variety of two dimensional display patterns is not necessary, as where specific standardized visual shapes (e.g., numerals, letters, words, etc.) are to be formed and image resolution is not critical, the conductors may be shaped accordingly, i.e., a segmented display.

The gas is one which produces visible light or invisible radiation which stimulates a phosphor and a copious supply of charges (ions and electrons) during discharge.

In prior art, a wide variety of gases and gas mixtures have been utilized as the gaseous medium in a gas discharge device. Typical of such gases include CO; CO_2; halogens; nitrogen; NH_3; oxygen; water vapor; hydrogen; hydrocarbons; P_2O_5; boron fluoride, acid fumes; $TiCl_4$; Group VIII gases; air; H_2O_2; vapors of sodium, mercury, thallium, cadmium, rubidium, and cesium; carbon disulfide, laughing gas; H_2S; deoxygenated air; phosphorus vapors; C_2H_2; CH_4; naphthalene vapor; anthracene; freon; ethyl alcohol; methylene bromide; heavy hydrogen; electron attaching gases; sulfur hexafluoride; tritium; radioactive gases; and the rare or inert gases.

In a preferred practice, the gaseous medium comprises at least one rare gas, more preferably at least two, selected from helium, neon, argon, krypton, or xenon.

In an open cell Baker, et al. type panel, the gas pressure and the electric field are sufficient to laterally confine charges generated on discharge within elemental or discrete dielectric areas within the perimeter of such areas, especially in a panel containing non-isolated discharge cells. As described in the Baker, et al. patent, the space between the dielectric surfaces occupied by the gas is such as to permit photons generated on discharge in a selected discrete or elemental volume of gas to pass freely through the gas space and strike surface areas of dielectric remote from the selected discrete volumes, such remote, photon struck dielectric surface areas thereby emitting electrons so as to condition at least one elemental volume other than the elemental volume in which the photons originated.

With respect to the memory function of a given discharge panel, the allowable distance or spacing between the dielectric surfaces depends, inter alia, on the frequency of the alternating current supply, the distance typically being greater for lower frequencies.

While the prior art does disclose gaseous discharge devices having externally positioned electrodes for initiating a gaseous discharge, sometimes called "electrodeless discharge", such prior art devices utilized frequencies and spacing or discharge volumes and operating pressures such that although discharges are initiated in the gaseous medum such discharges are ineffective or not utilized for charge generation and storage at higher frequencies; although charge storage may be realized at lower frequencies, such charge storage has not been utilized in a display/memory device in the manner of the Bitzer-Slottow or Baker, et al. invention.

The term "memory margin" is defined herein as

$$M.\,M. = \frac{V_f - V_E}{V_f/2}$$

where V_f is the half amplitude of the smallest sustaining voltage signal which results in a discharge every half cycle, but at which the cell is not bi-stable and V_E is the half amplitude of the minimum applied voltage sufficient to sustain discharges once initiated.

It will be understood that the basic electrical phenomenon utilized in this invention is the generation of charges (ions and electrons) alternately storable at pairs of opposed or facing discrete points or areas on a pair of dielectric surfaces backed by conductors connected to a source of operating potential. Such stored charges result in an electrical field opposing the field produced by the applied potential that created them and hence operate to terminate ionization in the elemental gas volume between opposed or facing discrete points or areas of dielectric surface. The term "sustain a discharge" means producing a sequence of momentary discharges, at least one discharge for each half cycle of applied alternating sustaining voltage, once the elemental gas volume has been fired, to maintain alternate storing of charges at pairs of opposed discrete areas on the dielectric surfaces.

As used herein, a cell is in the "on state" when a quantity of charge is stored in the cell such that on each half cycle of the sustaining voltage, a gaseous discharge is produced.

In addition to the sustaining voltage, other voltages may be utilized to operate the panel, such as firing, addressing, and writing voltages.

A "firing voltage" is any voltage, regardless of source, required to discharge a cell. Such voltage may be completely external in origin or may be comprised of internal cell wall voltage in combination with externally originated voltages.

An "addressing voltage" is a voltage produced on the panel X-Y electrode coordinates such that at the selected cell or cells, the total voltage applied across the cell is equal to or greater than the firing voltage whereby the cell is discharged.

A "writing voltage" is an addressing voltage of sufficient magnitude to make it probable that on subsequent sustaining voltage half cycles, the cell will be in the "on state".

In the operation of a multiple gaseous discharge device, of the type described hereinbefore, it is necessary

to condition the discrete elemental gas volume of each discharge cell by supplying at least one free electron thereto such that a gaseous discharge can be initiated when the cell is addressed with an appropriate voltage signal.

The prior art has disclosed and practiced various means for conditioning gaseous discharge cells.

One such means of panel conditioning comprises a so-called electronic process whereby an electronic conditioning signal or pulse is periodically applied to all of the panel discharge cells, as disclosed for example in British patent specification No. 1,161,832, page 8, lines 56 to 76. Reference is also made to U.S. Patent No. 3,559,190 and "The Device Characteristics of the Plasma Display Element" by Johnson, et al., IEEE Transactions On Electron Devices, September, 1971. However, electronic conditioning is self-conditioning and is only effective after a discharge cell has been previously conditioned; that is, electronic conditioning involves periodically discharging a cell and is therefore a way of maintaining the presence of free electrons. Accordingly, one cannot wait too long between the periodically applied conditioning pulses since there must be at least one free electron present in order to discharge and condition a cell.

Another conditioning method comprises the use of external radiation, such as flooding part or all of the gaseous medium of the panel with ultraviolet radiation. This external conditioning method has the obvious disadvantage that it is not always convenient or possible to provide external radiation to a panel, especially if the panel is in a remote position. Likewise, an external UV source requires auxiliary equipment. Accordingly, the use of internal conditioning is generally preferred.

One internal conditioning means comprises using internal radiation, such as by the inclusion of a radioactive material.

Another means of internal conditioning, which we call photon conditioning, comprises using one or more so-called pilot discharge cells in the on-state for the generation of photons. This is particularly effective in a so-called open cell construction (as described in the Baker, et al. patent) wherein the space between the dielectric surfaces occupied by the gas is such as to permit photons generated on discharge in a selected discrete or elemental volume of gas (discharge cell) to pass freely through the panel gas space so as to condition other and more remote elemental volumes of other discharge units. In addition to or in lieu of the pilot cells, one may use other sources of photons internal to the panel.

Internal photon conditioning may be unreliable when a given discharge unit to be addressed is remote in distance relative to the conditioning source, e.g., the pilot cell. Accordingly, a multiplicity of pilot cells may be required for the conditioning of a panel having a large geometric area. In one highly convenient arrangement, the panel matrix border (perimeter) is comprised of a plurality of such pilot cells.

In gas discharge devices of the aformentioned types, is color displays are desired, phosphors may be appropriately positioned within the device so as to be excited by radiation from the gas discharge of the device. For example, in a memory charge storage device of the Baker et al. type, phosphors can be positioned on or be embedded in one or more charge storage dielectric surfaces, such as disclosed in copending U.S. patent application Ser. No. 101,433, filed Dec. 24, 1970 by Robert N. Clark, now U.S. Pat. No. 3,701,658, and assigned to the same assignee as the instant application.

The presence of the phosphors within the device can be utilized to provide color display, the color being the result of radiation emitted by an excited phosphor alone or in combination with radiation emitted by the gas discharge, such as disclosed in copending U.S. patent application Ser. No. 199,802, filed Nov. 17, 1971 by Felix H. Brown and Maclin S. Hall and assigned to the same assignee as the instant application.

In accordance with this invention, there is disclosed the photon conditioning of a gaseous discharge phosphor color display device which comprises providing within the device at least two different phosphors, each phosphor being excited by ultraviolet radiation emitted from the gaseous discharge or another source, one phosphor emitting light in the visible range for viewing of the display and another phosphor emitting radiation in the near UV non-visible range for the efficient photon conditioning of the gaseous medium without exciting the other phosphor.

More particularly, there is utilized within a gaseous display/memory device of the Baker, et al. type at least one phosphor which absorbs radiation in the vacuum UV range and emits radiation in the near UV range and at least one other phosphor which is excited by vacuum UV range, but is not excited by radiation in the near UV range and emits radiation in the visible range.

In the practice of this invention, it is contemplated using any suitable luminescent phosphor. In the preferred embodiment, the phosphor is photoluminescent. The term "photoluminescent phosphor" includes quite generally all solid and liquid, inorganic and organic materials capable of converting an imput of absorbed photons into an output of photons of different energy, the output comprising visible light of a brightness and intensity sufficient for visual display.

Typical photoluminescent phosphors contemplated include, not by way of limitation, both activated and non-activated compounds, e.g., the sulfides such as zone sulfides, zinc-cadmium sulfides, zinc-sulfoselenides; the silicates such as zinc silicates, zinc beryllo-silicates, Mg silicates; the tungstates such as calcium tungstates, magnesium tungstates; the phosphates, borates, and arsenates such as calcium phosphates, cadmium borates, zinc borates, magnesium arsenates; and the oxides and halides such as self-activated zinc oxide, magnesium fluorides, magnesium fluorogermanate. Typical activators include, not by way of limitation, Mn, Eu, Ce, Pb, Mg, etc.

One preferred phosphor which absorbs radiation in the vacuum UV range and emits radiation in the near UV range is Sylvania Phosphor Type 2061 which comprises strontium hexaborate activated by lead. It is excited (absorbs) by a wavelength of about 240 to 280 nanometers (peak of 273) and has an emission spectrum of about 280 to 320 nanometers (peak of 291).

Another such phosphor is P16 as defined by JEDEC Electrode Tube Council, Publication No. 16A of January, 1966, revised February, 1969. This phosphor comprises a Ca-Mg silicate activated by cerium.

Examples of phosphors which absorb radiation in the vacuum UV range but not in the near UV range and emit radiation in the visible range include zinc silicate activated with Mn; calcium tungstate activated with Pb; and yttrium vanadate or oxide activated with Eu.

Reference is made to the accompanying drawings and the hereinafter discussed figures shown thereon.

FIG. **1** is a partially cut-away plan view of a gaseous discharge display/memory panel as connected to a diagrammatically illustrated source of operating potentials.

FIG. **2** is a cross-sectional view (enlarged, but not to proportional scale since the thickness of the gas volume, dielectric members and conductor arrays have been enlarged for purposes of illustration) taken on lines **2 — 2** of FIG. **1.**

FIG. **3** is an explanatory partial cross-sectional view similar to FIG. **2** (enlarged, but not to proportional scale).

FIG. **4** is an isometric view of a gaseous discharge display/memory panel.

The invention utilizes a pair of dielectric films **10** and **11** separated by a thin layer or volume of a gaseous discharge medium **12**, the medium **12** producing a copious supply of charges (ions and electrons) which are alternately collectible on the surfaces of the dielectric members at opposed or facing elemental or discrete areas X and Y defined by the conductor matrix on non-gas-contacting sides of the dielectric members, each dielectric member presenting large open surface areas and a plurality of pairs of elemental X and Y areas. While the electrically operative structural members such as the dielectric members **10** and **11** and conductor matrixes **13** and **14** are all relatively thin (being exaggerated in thickness in the drawings) they are formed on and supported by rigid nonconductive support members **16** and **17** respectively.

Preferably, one or both of nonconductive support members **16** and **17** pass light produced by discharge in the elemental gas volumes. Preferably, they are transparent glass members and these members essentially define the overall thickness and strength of the panel. For example, the thickness of gas layer **12** as determined by spacer **15** is usually under 10 mils and preferably about 3 to 6 mils, dielectric layers **10** and **11** (over the conductors at the elemental or discrete X and Y areas) are usually between 1 and 2 mils thick, and conductors **13** and **14** about 8,000 angstroms thick. However, support members **16** and **17** are much thicker (particularly in larger panels) so as to provide as much ruggedness as may be desired to compensate for stresses in the panel. Support members **16** and **17** also serve as heat sinks for heat generated by discharges and thus minimize the effect of temperature on operation of the device. If it is desired that only the memory function be utilized, then none of the members need be transparent to light.

Except for being nonconductive or good insulators the electrical properties of support members **16** and **17** are not critical. The main function of support members **16** and **17** is to provide mechanical support and strength for the entire panel, particularly with respect to pressure differential acting on the panel and thermal shock. As noted earlier, they should have thermal expansion characteristics substantially matching the thermal expansion chacteristics of dielectric layers **10** and **11.** Ordinary ¼ inch commercial grade soda lime plate glasses have been used for this purpose. Other glasses such as low expansion glasses or transparent devitrified glasses can be used provided they can withstand processing and have expansion characteristics substantially matching expansion characteristics of the dielectric coatings **10** and **11**. For given pressure differentials and thickness of plates, the stress and deflection of plates may be determined by following standard stress and strain formulas (see R. J. Roark, *Formulas for Stress and Strain*, McGraw-Hill, 1954).

Spacer **15** may be made of the same glass material as dielectric films **10** and **11** and may be an integral rib formed on one of the dielectric members and fixed to the other members to form a bakeable hermetic seal enclosing and confining the ionizable gas volume **12**. However, a separate final hermetic seal may be effected by a high strength devitrified glass sealant **15S**. Tubulation **18** is provided for exhausting the space between dielectric members **10** and **11** and filling that space with the volume of ionizable gas. For large panels small beadlike solder glass spacers such as shown at **15B** may be located between conductor intersections and fused to dielectric member **10** and **11** to aid in withstanding stress on the panel and maintain uniformity of thickness of gas volume **12**.

Conductor arrays **13** and **14** may be formed on support members **16** and **17** by a number of well-known processes, such as photoetching, vacuum deposition, stencil screening, etc. In the panel shown in FIG. **4**, the center-to-center spacing of conductors in the respective arrays is about 17 mils. Transparent or semitransparent conductive materials such as tin oxide, gold or aluminum can be used to form the conductor arrays and should have a resistance less than 3000 ohms per line. Narrow opaque electrodes may alternately be used so that discharge light passes around the edges of the electrodes to the viewer. It is important to select a conductor material that is not attacked during processing by the dielectric material.

It will be appreciated that conductor arrays **13** and **14** may be wires or filaments of copper, gold, silver or aluminum or any other conductive metal or material. For example 1 mil wire filaments are commercially available and may be used in the invention. However, formed in situ conductor arrays are preferred since they may be more easily and uniformly placed on and adhered to the support plates **16** and **17**.

Dielectric layer members **10** and **11** are formed of an inorganic material and are preferably formed in situ as an adherent film or coating which is not chemically or physically effected during bake-out of the panel. One such material is a solder glass such as Kimble SG-68 manufactured by and commercially available from the assignee of the present invention.

This glass has thermal expansion characteristics substantially matching the thermal expansion characteristics of certain soda-lime glasses, and can be used as the dielectric layer when the support members **16** and **17** are soda-lime glass plates. Dielectric layers **10** and **11** must be smooth and have a dielectric strength of about 1000 v. and be electrically homogeneous on a microscopic scale (e.g., no cracks, bubbles, crystals, dirt, surface films, etc.). In addition, the surfaces of dielectric layers **10** and **11** should be good photoemitters of electrons in a baked out condition. Alternatively, dielectric layers **10** and **11** may be overcoated with materials designed to produce good electron emission, as in U.S. Pat. No. 3,634,719, issued to Roger E. Ernsthausen. Of course, for an optical display at least one of dielectric layers **10** and **11** should pass light generated on discharge and be transparent or translucent, and preferably, both layers are optically transparent.

The preferred spacing between surfaces of the dielectric films is about 3 to 6 mils with conductor arrays **13** and **14** having center-to-center spacing of about 17 mils.

The ends of conductors **14-1** . . . **14-4** and support member **17** extend beyond the enclosed gas volume **12** and are exposed for the purpose of making electrical connection to interface and addressing circuitry **19**. Likewise, the ends of conductors **13-1** . . . **13-4** on support member **16** extend beyond the enclosed gas volume **12** and are exposed for the purpose of making electrical connection to interface and addressing circuitry **19**.

As in known display systems, the interface and addressing circuitry or system **19** may be relatively inexpensive line scan systems or the somewhat more expensive high speed random access sytems. In either case, it is to be noted that a lower amplitude of operating potentials helps to reduce problems associated with the interface circuitry between the addressing system and the display/memory panel, per se. Thus, by providing a panel having greater uniformity in the discharge characteristics throughout the panel, tolerances and operating characteristics of the panel with which the interfacing circuitry cooperate, are made less rigid.

I claim:

1. In a multiple gaseous discharge display device characterized by an ionizable gaseous medium in a gas chamber formed by a sealed envelope and a pair of spaced arrays of electrode members, the envelope comprising a dielectric material and including at least a transparent portion for viewing the display, the electrode members of one array being transversely oriented with respect to the electrode members of the other array so as to define a plurality of discharge units, said discharge units being in open photonic communication, and the gaseous medium being capable of being placed in a conditioned state by ions generated by photons, the improvement wherein said device further comprises a first phosphor means excitable by radiation emitted by a gaseous discharge within said chamber and emitting radiation in the near UV non-visible range upon excitation for efficient photon conditioning of said gaseous medium and further comprising a second phosphor means excitable by radiation emitted by a gaseous discharge within said chamber and emitting light in the visible range upon excitation for viewing of the display and not being excitable by said radiation in the near UV non-visible range emitted by said first recited phosphor means.

2. The device according to claim **1** wherein both said first recited phosphor means and said second phosphor means are excitable by radiation in the vacuum UV range emitted by a gaseous discharge within said chamber.

3. In a multiple gaseous discharge display/memory device characterized by an ionizable gaseous medium in a gas chamber formed by a pair of opposed dielectric material charge storage members, each backed by an array of electrode members, the electrode members of one array being transversely oriented with respect to the electrode members of the other array so as to define a plurality of discharge units, said discharge units being in open photonic communication, and said dielectric material charge storage members being adapted to emit electrons when struck by photons to condition said gaseous medium, the improvement wherein said device further comprises at least first and second phosphor means, each said phosphor means being excitable by radiation emitted by a gaseous discharge within said chamber, said first phosphor means emitting radiation in the near UV non-visible range upon excitation for efficient photon conditioning of said gaseous medium, and said second phosphor means emitting light in the visible range upon excitation for viewing of the display and not being excitable by said radiation in the near UV non-visible range emitted by said first phosphor means.

4. The device according to claim **3** wherein both said phosphor means are excitable by radiation in the vacuum UV range emitted by a gaseous discharge within said chamber.

5. The invention of claim **4** wherein said first phosphor means which emits in the near UV range is selected from strontium hexaborate activated by lead and calcium-magnesium silicate activated by cerium.

6. The invention of claim **5** wherein said second phosphor means which emits radiation in the visible range is selected from zinc silicate activated with manganese, calcium tungstate activated with lead, yttrium vanadate activated with europium and yttrium oxide activated with europium.

7. The invention of claim **6** wherein the gaseous medium consists essentially of at least one rare gas selected from Ne, Ar, Kr, and Xe.

8. The invention of claim **7** wherein the gaseous medium contains up to 10 percent atoms of helium.

9. In the operation of a multiple gaseous discharge display devices characterized by an ionizable gaseous medium in a gas chamber formed by a sealed envelope and a pair of spaced arrays of electrode members, the envelope comprising a dielectric material and including at least a transparent portion for viewing the display, the electrode members of one array being transversely oriented with respect to the electrode members of the other array so as to define a plurality of discharge units, said discharge units being in open photonic communication, and the gaseous medium being capable of being placed in a conditioned state by ions generated by photons, the improvement wherein the photon conditioning of the ionizable gaseous medium is improved by providing at least first and second phosphor means within said chamber and selectively exciting each said phosphor means by radiation emitted from at least one gaseous discharge within said chamber to cause said first phosphor means to emit radiation in the near UV non-visible range to efficiently photonically condition the gaseous medium and to cause said second phosphor means to emit light in the visible range for viewing of the display, said second phosphor means not being excitable by said radiation in the near UV non-visible range emitted by said first phosphor means whereby interference with the display is avoided.

10. In the operation of a multiple gaseous discharge display/memory device characterized by an ionizable gaseous medium in a gas chamber formed by a pair of opposed dielectric material charge storage members, each baked by an array of electrode members, the electrode members of one array being transversely oriented with respect to the electrode members of the other array so as to define a plurality of discharge units, said discharge units being in open photonic communication, and said dielectric material charge storage members being adapted to emit electrons when struck by photons to condition said gaseous medium, the improvement wherein the photon conditioning of the ionizable gaseous medium is improved by providing at least first and second phosphor means within said chamber and selectively exciting each said phosphor means by radiation emitted from at least one gaseous discharge within said chamber to cause said first phosphor means to emit radiation in the near UV non-visible range for efficiently photonically condition said gaseous medium and to cause said second phosphor means to emit light in the visible range for viewing of the display, said second phosphor means not being excitable by said radiation in the near UV non-visible range emitted by said first phosphor means whereby interference with the display is avoided.

11. As an article of manufacture, a dielectric body for a gaseous discharge display/memory device, said dielectric body containing at least first and second phosphor means, each said phosphor means being sensitive to and excitable by radiation emitted by a gaseous discharge, said first phosphor means emitting radiation in the near UV non-visible range upon excitation for efficient photon conditioning of a gaseous medium and said second phosphor means emitting light in the visible range upon excitation for viewing of a display and not being excitable by said radiation in the near UV non-visible range emitted by said first phosphor means.

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