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Kippenhan

[11] **3,760,403**

[45] **Sept. 18, 1973**

[54] **GAS PANEL DISPLAY HAVING MONOGRAM TYPE CHARACTERS WITH MATRIX ADDRESSABLE STROKES**

[75] Inventor: **B. William Kippenhan,** Hyde Park, N.Y.

[73] Assignee: **International Business Machines Corporation,** Armonk, N.Y.

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[52] U.S. Cl. ..... **340/336,** 178/30, 340/324 M, 340/343

[51] **Int. Cl.** **G09f 9/30**

[58] **Field of Search** ..... 340/324 M, 336, 343, 340/173 PL; 178/30

[56] **References Cited**

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Primary Examiner—John W. Caldwell
Assistant Examiner—Marshall M. Curtis
Attorney—Frederick D. Poag et al.

[57] **ABSTRACT**

A high resolution gaseous discharge display comprises an encapsulated panel array of bistable charge storage areas defining linearly shaped discharge cells or sites, each cell being defined by a pair of congruent linear portions formed by generally orthogonally arranged conductors insulated from direct contact with the gas by a dielectric, which, when properly energized, produce a confined gaseous discharge in the selected cell. The cells are arranged in character font areas in columns and rows at the intersections of groups of the conductor lines, the conductors being configured at the character positions to define linear cells constituting character font strokes or elements.

11 Claims, 7 Drawing Figures

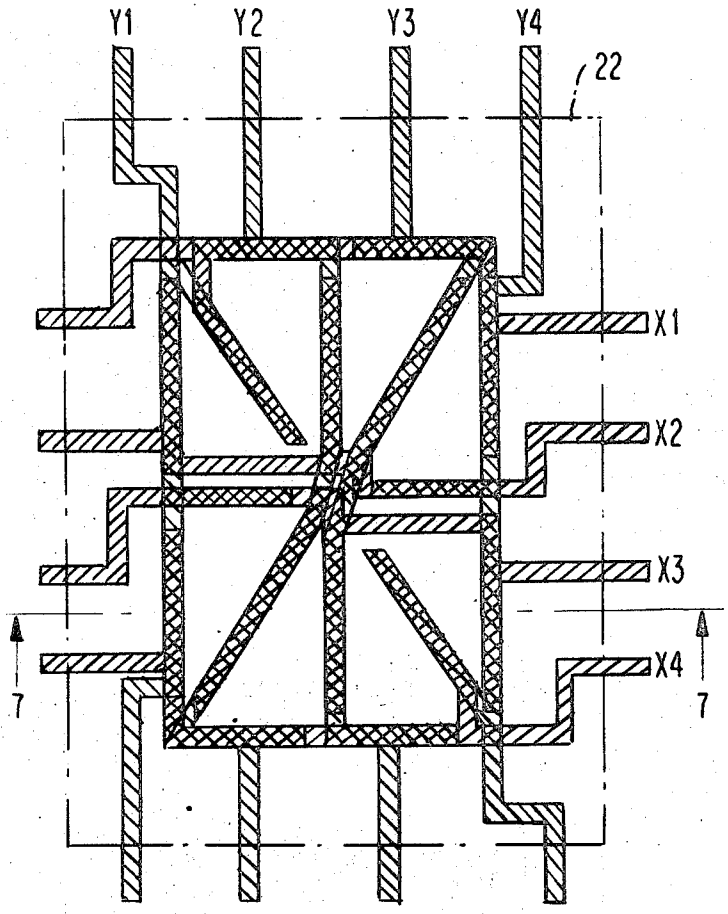


FIG. 1

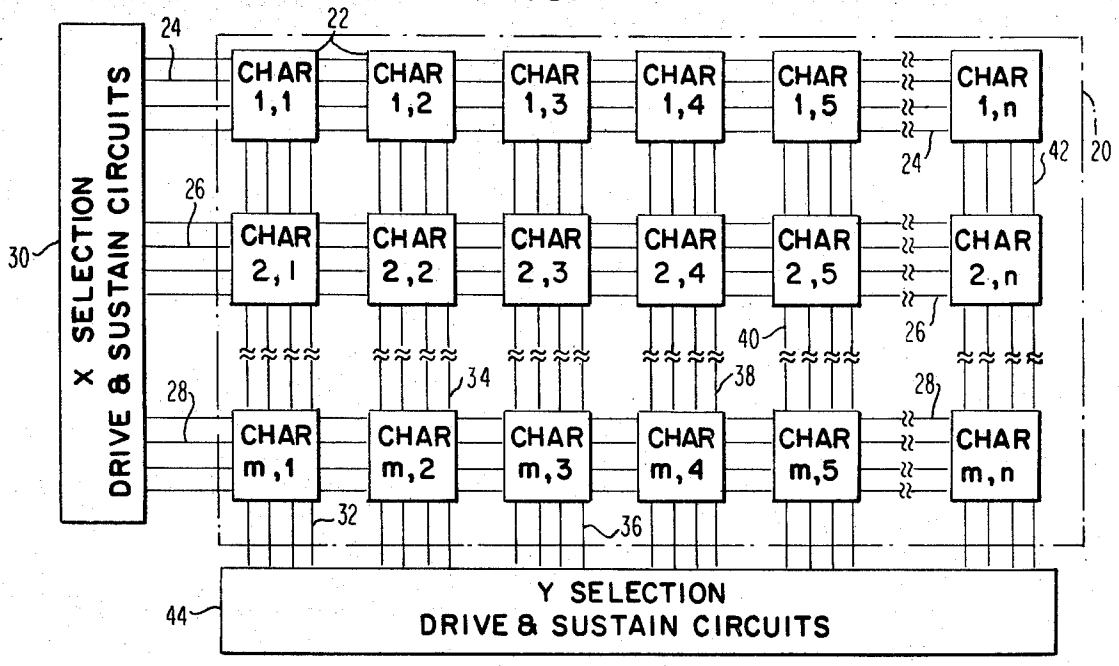


FIG.6

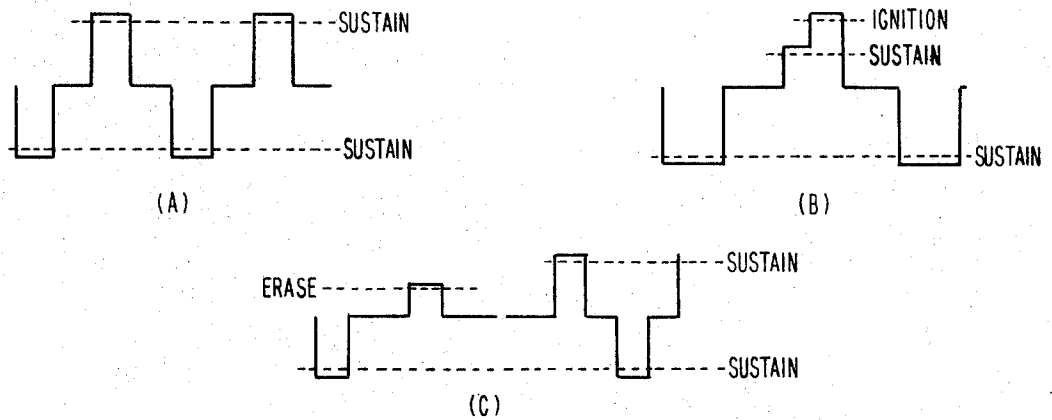
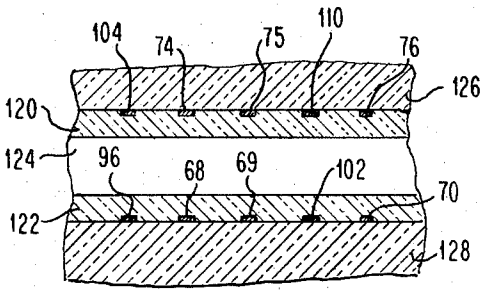


FIG. 7



INVENTOR
B. WILLIAM KIPPENHAN

BY Frederick D. Bragg

ATTORNEY

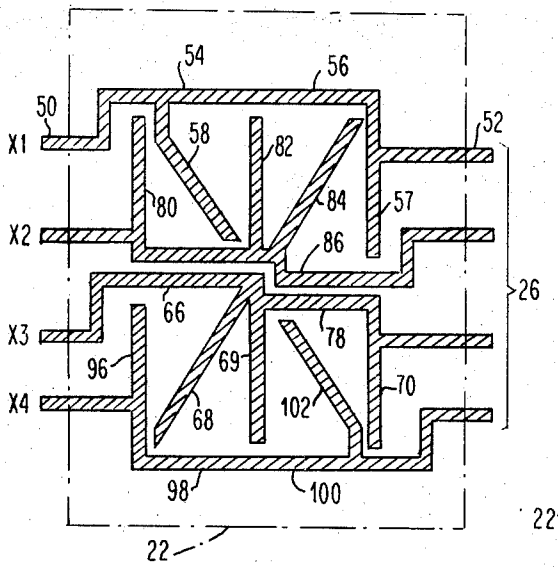


FIG. 2

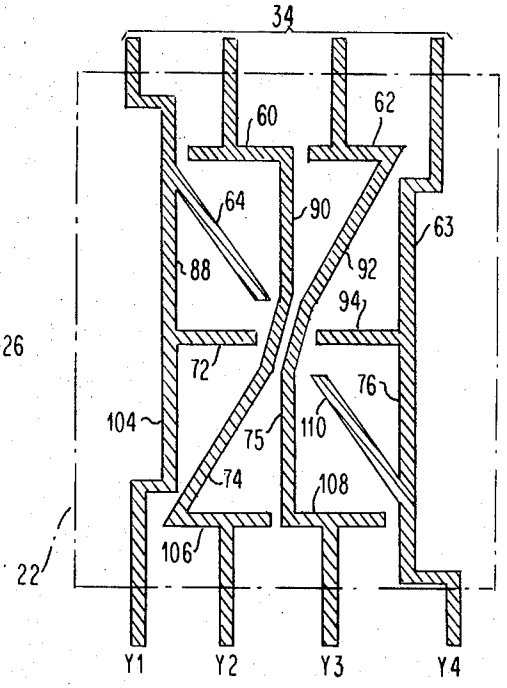


FIG. 3

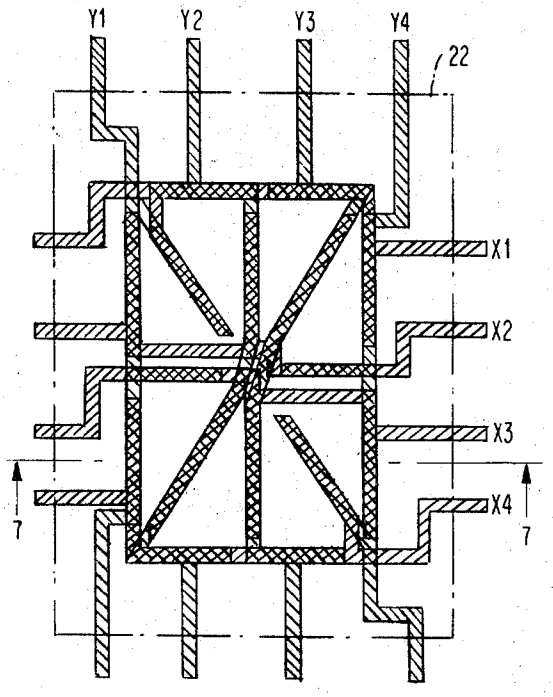


FIG. 4

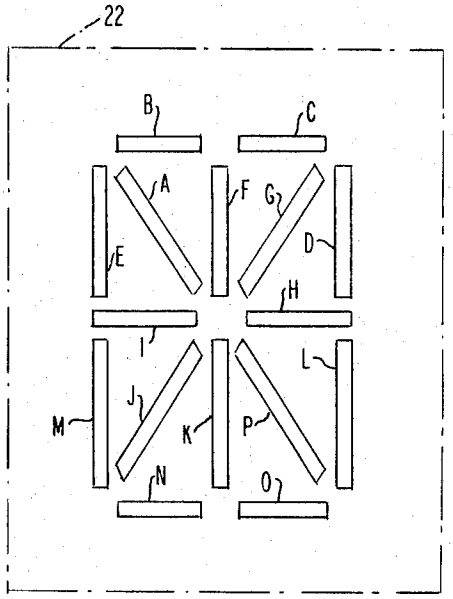


FIG. 5

GAS PANEL DISPLAY HAVING MONOGRAM TYPE CHARACTERS WITH MATRIX ADDRESSABLE STROKES

BACKGROUND OF THE INVENTION

This invention relates to display matrices and more particularly to a plasma or gaseous discharge display characterized by matrix grids of such configuration as to yield linear areas of congruence at cross-over regions of the respective arrays of the matrix, so as to yield character stroke or font elements which are each addressable by a pair of conductors.

In the prior art of gas panel displays, the display may be generated as a multiplicity of individual points corresponding to the cross-over areas of individual straight line conductors of a coordinate pair in the two arrays. While a display of this kind has great flexibility, a great many separately addressable conductors are needed to provide fine resolution. Alternatively, fewer conductors can be provided and a minimum number of dots such as, for example, a five by seven matrix, can be utilized for each character.

Other prior art displays have utilized the so-called "double hung window" arrangement of stroke areas. However, in displays requiring a very thin structure, such as a gas panel display, prior art methods of wiring to the individual stroke areas would be incompatible with the need for simplicity, transparency and microminiaturization of the metallizations in the display.

SUMMARY OF THE INVENTION

In accordance with the present invention, a character display may comprise a display panel having a voltage energizable display medium in a plane medially therewithin, first and second arrays of conductors in relatively outer planes of said panel embracing said medium, and circuits connected individually to said arrays to provide matrix initiation, maintenance and extinction of operative voltage stresses within the medium at configured areas of congruence between conductors of the first array with conductors of the second array. Moreover, the first array may comprise a plurality of conductor groups, each group corresponding to a column of character positions in said display, and the second array may comprise a plurality of conductor groups, each group corresponding to a row of character positions individually corresponding with character positions of said columns of character positions, the conductors of the first group and the second group at said character positions being configured to have linear areas of congruence with each other in said character positions, the areas of linear congruence constituting character stroke positions individually selectable by matrix energization of a corresponding conductor in each of the first and second groups.

Accordingly, it is a principle object of the present invention to provide an improved display having well defined characters with minimum matrix addressing lines and logic.

Another object of the invention is to provide a display as aforesaid in which problems of fabrication and construction are minimized.

Yet another object of the invention is to provide a display as aforesaid wherein matrix conductors are provided with configured and/or salient conductor elements such that, although the separate conductors in one plane do not intersect or cross each other, they nevertheless can produce substantially intersecting or interleaved display lines.

Still another object of the invention is to provide a matrix display having complex land geometries in character positions which provide areas of matrix congruence yielding linear character font elements, without the necessity of cross-overs in either conductor array of the matrix.

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

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a diagramatic representation of a gaseous discharge display having a character matrix panel in accordance with the invention.

FIGS. 2 and 3 show conductor patterns for the X and Y lines, respectively, within a character position of FIG. 1.

FIG. 4 shows a superposition of the patterns of FIGS. 2 and 3.

FIG. 5 is a diagram showing the approximate areas of congruence of the superposed patterns of FIG. 4.

FIG. 6 is a diagramatic showing of signal wave forms employed in the operation of the display of FIG. 1.

FIG. 7 is a diagramatic cross-section of the display panel of FIG. 1 taken about along a line corresponding to the position 7—7 shown in FIG. 4.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to the drawings and more particularly to FIG. 1 thereof, there is illustrated a gas panel indicated at 20 having a plurality of character positions 22. In the illustrated embodiment the character positions are arranged in a grid having columns 1, 1 – m, 1 through 1,n – m,n, and rows 1,1 — 1,n through m,1–m,n. The character positions in each row are connected by a plurality of X lines 24, 26, 28 to X Selection, Drive and Sustain circuits 30. The character positions of each column are connected by Y lines 32, 34, 36, 38, 40, 42 to Y Selection, Drive and Sustain circuits 44. The gas panel 20 includes an illuminable gas such as a mixture of neon and argon within a sealed envelope, the vertical and horizontal conductor array being positioned in orthogonal relationship on opposite sides of the envelope. Gas cells within the envelope are selectively ignited or fired during a write operation by applying to the associated pair of conductors coincident signals having a magnitude sufficient to cause the gas voltage to exceed the breakdown voltage. In the preferred embodiment the control potentials for write, read and erase operations are rectangular AC signals of the type described in copending application Ser. No. 885,086 for "Improved Method and Apparatus for a Gas Display Panel" filed by Tony N. Criscimagna et al. Dec. 15, 1969, and assigned to the assignee of the present application. In a gas panel display of this kind, areas of illumination or potential illumination, referred to as cells, are formed by the areas of congruence (i.e., coincident points) of opposing X and Y conductors on opposite sides of the envelope.

In accordance with the present invention the X and Y conductors are so configured as to provide areas of congruence corresponding to linear font elements or character strokes, whereby a character with good definition can be formed with a minimum number of par-

ticipating X and Y conductors. FIGS. 2 and 3 show configuration of the X and Y conductors in the region of any of the character positions 22 of FIG. 1. The relationship of the patterns to any such area 22 is shown by the phantom outline in FIGS. 2–5. For example, the character position shown may be character position 2,2 of FIG. 1, in which case the X drive lines shown will be group 26 and the Y drive lines shown will be group 34.

Referring more particularly to FIGS. 2 and 3, line X1 of group 26 is a through line having portions 50 and 52 extending to adjacent character positions in the same row and eventually to the X selection drive and sustain circuits 30. Similarly, Lines X2—X4 and Y1–Y4 extend through the matrix to circuits 30 and 44, respectively. Within the character position 22 line X1 is configured to have portions 54, 56, 57 and 58, in voltage communication with through connections 50, 52 and comprising lands located for registration with companion lands in conductors Y1, Y2, Y3 and Y4 of FIG. 3 to define four corresponding cells or luminations sites in the gas panel. In like manner each of the X lines of FIG. 2 has segments for registration with segments of Y lines in FIG. 3. For example, line X3 of FIG. 2 has segments 66, 68, 69 and 70 positioned for registration with lines 72, 74, 75 and 76, respectively, of lines Y1, Y2, Y3 and Y4 of FIG. 3. It should be noted that line segment 78 does not register with any line segment in FIG. 3 and is provided only for communication within line X3 and not as a gas cell or illumination site defining land in the display.

In like manner, line X2 of FIG. 2 has segments 80, 82, 84, 86 which register with segments 88, 90, 92, 94 of line Y1, Y2, Y3 and Y4 of FIG. 3, and line X4 of FIG. 2 has segments 96, 98, 100, 102 which register with segments 104, 106, 108, 110 of lines Y1, Y2, Y3 and Y4 of FIG. 3.

FIG. 4 shows the operative superposition of the patterns of FIGS. 2 and 3. The individual shading patterns of FIGS. 2 and 3 are carried into FIG. 4 so that the double shaded areas show the approximate areas of congruence. These areas are repeated in FIG. 5 in somewhat idealized form as areas A through M which correspond to the segments of FIGS. 2 and 3 as follows.

TABLE 1

ILLUMINATION SITE OR CELL, FIG. 5	X, Y SEGMENTS, Figs. 2, 3
A	58, 64
B	54, 60
C	56, 62
D	57, 63
E	80, 88
F	82, 90
G	84, 92
H	86, 94
I	66, 72
J	68, 74
K	69, 75
L	70, 76
M	96, 104
N	98, 106
O	100, 108
P	102, 110

It will be seen, then, that the energization of X, Y line pairs of any particular character position 22 for illumination of a particular illumination site or cell of that character position is as follows:

TABLE 2

X1	A	B	C	D
X2	E	F	G	H
X3	I	J	K	L
X4	M	N	O	P
	Y1	Y2	Y3	Y4

In other words, to illuminate segment A of character position 2,2, lines X1 and Y1 of line groups 26 and 34, respectively, are employed. To illuminate segment B of that character position, lines X1 and Y2 of those line groups are employed, and so on. The lumination of segments B, C, G and J will form a "seven," for example. In like manner, an extensive set of alphabetic, numeric, and arbitrary characters or symbols can be created.

Energization of the various X and Y lines to achieve a display of a number of such characters is achieved by operation of X Selection Drive and Sustain circuits 30 and Y Selection Drive and Sustain circuits 44. Circuits 30 and 44 may be of any suitable kind appropriate to operation of the display. The details of such circuits and their operation do not, per se, form a part of the present invention. Rather, the present invention provides an improvement in the electrode configuration of the display, and the consequent reduction of the number of X, Y lines in a matrix for providing a display of a given resolution. The operation of one suitable X, Y matrix energization scheme is illustrated in summary form in the diagrams of FIG. 6.

Diagram A of FIG. 6 illustrates the net voltage difference across each of the cells or illumination sites during sustain operation. For a sustain operation a first square wavetrain is applied to all X conductors, and a second square wave train, displaced 90° from the first square wave train, is applied to all of the Y conductors. The result is a suare wave train potential difference of Diagram A across all gas cells equal to or greater than the sustain level.

For a write operation, the signal shown in Diagram B is applied to the selected cell. To accomplish this, the frequency of the first and second square wavetrains is reduced, and a pulse is superimposed on the first and second square wave trains as follows: the resultant signal on the selected X conductor has an increased magnitude of one polarity; the resultant signal on the selected Y conductor has an increased magnitude of the opposite polarity; the resultant signals on the non-selected X conductors have a decreased magnitude; and the resultant signals on the non-selected Y conductors have a decreased magnitude whereby the resulting potential difference across the selected cell, and only the selected cell, exceeds the ignition potential of the gas. All of the remaining gas cells receive a sustain signal level. The sustain operation takes place with the leading edge of the potential difference wave train, and the write operation takes place at the trailing edge portion of this wave train whereby "spill" over to adjacent cells is minimized. The reduction in frequency during a write operation further separates these two events.

Diagram C shows the waveforms applied in sequence to a cell selected for erasure. For an erase operation the first and second square wave trains are latched down, and a pulse is superimposed on the Y and X conductors as follows: the resultant signal on the selected X conductor is decreased; the resultant signal on the selected Y conductor is increased whereby the potential difference across the selected cell is reduced below the sustain level; the resultant signal on the non-selected X conductors is increased; whereas the signals on the non-selected Y conductors is decreased. A potential difference, less than the sustain level, is applied across

the selected gas cell, and this pulse has a polarity opposite to the polarity of the last sustain pulse whereby the gas in the selected cell is driven toward a state of lower molecular activity, and after a suitable delay, as indicated by the break in the diagram, sustain operations are reinitiated.

Further details of a gas panel display system of this kind shown and described in an article entitled "Additive Pulses 'Turn On' Display Cells — Reliably" by Tony N. Criscimagna published in Electro-Optical System Design, Vol. 3, No. 9, Aug. 1971, pages 32–37, and in U. S. Pat. application Ser. No. 885,086 filed Dec. 15, 1969, and assigned to the assignee of this application.

Gas panel operating arrangements of the above referenced kind rely on electric field and wall charge localization to define the boundaries of "cells," or illumination sites in the gas. Referring to FIG. **7**, this permits the panel **22** to be of open internal construction, that is, without physical barriers between the cells. Thus the panel construction may comprise a dielectric envelope having walls **120, 122** and containing an ionizable illuminable gas **124,** such as a mixture of neon and argon or nitrogen. Conductors embrace the dielectric envelope **120, 122** on opposite sides of, but separated by the dielectric from, the layer of gas **124.** As shown, these conductors may be in the configuration shown in FIGS. **2, 3** and **4.** The panel is completed by outer glass layers **126, 128,** providing structural support for X, Y conductors and dielectric, and suitable connections from the X, Y conductors and circuits **30** and **44.**

If, on a particular half-cycle of the alternating potential connected to a pair of the conductors, for example conductors **X3** and **Y3,** the gas voltage exceeds a breakdown voltage, the gas becomes conductive through the voltage-induced production of electrons and gas ions, and the selected cell is said to have broken down. In this conductive state, electrons in the gas migrate to the wall which is temporarily positive, and the ions to the wall which is temporarily negative. The charged particles collected on the dielectric walls, or "wall charge," produce a potential between the dielectric surface and the conductors which opposes the externally applied potential, and thus reduces the gas voltage. As current continues to flow through the gas, the opposing wall charge increases until the gas voltage drops below that necessary to maintain the gas in a conductive state, and the current discharge is extinguished.

On the next half-cycle of the alternating external potential having a polarity opposite that of the preceding half-cycle, the voltage produced by the wall charge initially adds to that produced externally, so that the gas voltage is augmented. Thus the breakdown voltage of the gas is obtained at a lower value of external potential, a current discharge of opposite sense to the initial discharge is initiated, and a wall charge of opposite sign to the initial wall charge is established of sufficient magnitude to cause the discharge to be extinguished. Thus, after initial breakdown, the wall charge condition may be maintained in the selected cell by application of a lower potential designed the sustain signal which, combined with the wall charge, causes the selected cells to be reignited and extinguished continuously at a relatively high frequency to maintain a continuous display. In the illustrated case, the breakdown is between elements **69** and **65,** and the illuminated "cell" is defined by the area of congruency of those elements. Light output for display purposes is produced in that area of congruency during the passage of the discharge current.

Alternatively, a gas panel structure having an apertured spacer layer between the dielectric layers and operative to isolate the cells from each other physically may be utilized. An apertured construction, and a general energizing scheme therefor, have been described, for example, in U. S. Pat. No. 3,559,190 to Bitzer.

In either case, the display system of the present invention provides selection of character elements with a maximum of addressing efficiency. In the illustrated embodiment, each character position has sixteen elements individually addressable by selective use of four X through conductors and four Y through conductors, and the character positions are individually addressable by selective use of the X and Y conductor groups.

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

What is claimed is:

1. In a character display comprising a display panel having a voltage energizable display medium in a plane medially therewithin,

first and second arrays of conductors in relatively outer planes of said panel embracing said medium,

means connected individually to said arrays to provide matrix initiation, maintenance and extinction of operative voltage stresses within said medium at areas of congruence between conductors of said first array with conductors of said second array,

the improvement comprising

said first array comprising a plurality of multiple conductor groups, each group corresponding to a column of character positions in said display,

said second array comprising a plurality of multiple conductor groups, each group corresponding to a row of character positions individually congruent with character positions with said columns of character positions,

each of the conductors of said first group and said second group at said character positions being configured to have linear congruence with each conductor of the other group in said character positions,

the areas of linear congruence constituting character stroke positions individually selectable by matrix energization of a corresponding conductor in each of said first and second groups.

2. Apparatus in accordance with claim **1** wherein said conductors are formed with land areas in said character positions providing areas of linear congruence of character font element configuration.

3. Apparatus in accordance with claim **1** wherein said lines of said first array pass through said character positions in electrically parallel and non-intersecting relationship, and

wherein said lines of said second array pass through said character positions in electrically parallel and non-intersecting relationship,

whereby no line crossovers are required within either array.

4. Apparatus in accordance with claim **2** wherein said lines of said first array pass through said character posi-

tions in electrically parallel and non-intersecting relationship, and,

wherein said lines of said second array pass through said character positions in electrically parallel and non-intersecting relationship,

at least some of said land areas of at least one array including salient portions extending laterally of the corresponding conductor into congruence with land areas of the opposite array.

5. Apparatus in accordance with claim **1** wherein said display has a self-latching characteristic, whereby the lines of said arrays can be operated to address said character font elements selectively by coordinate conductors in said groups in a character position, with the character positions being addressed selectively by coordinate conductor groups,

so that an array of characters can be presented by said display in a flicker free manner.

6. Apparatus in accordance with claim **1,** wherein said display is a gas panel display and said medium is luminescent gas insulated from said conductors by dielectric envelope means.

7. Apparatus in accordance with claim **6** wherein said conductors are formed with land areas in said character positions providing areas of linear congruence of character font element configuration.

8. Apparatus in accordance with claim **7** wherein said lines of said first array pass through said character positions in electrically parallel and non-intersecting relationship, and

wherein said lines of said second array pass through said character positions in electrically parallel and non-intersecting relationship,

whereby no line crossovers are required within either array.

9. Apparatus in accordance with claim **8** wherein said lines of said first array pass through said character positions in a first single plane, and

wherein said lines of said second array pass through said character positions in a second single plane parallel to and spaced from said first plane,

at least some of said land areas of at least one array including salient portions in the corresponding plane extending laterally of the corresponding conductors into congruence with land areas of the opposite array,

whereby each character position can have individually selectable character font elements of up to the product of the number of lines in the corresponding line group of said first array multiplied by the number of lines in the corresponding line group of said second array.

10. Apparatus in accordance with claim **9** wherein said dielectric comprises wall charge storage means operative to maintain self latching luminescent operation at said areas of congruence.

11. Apparatus in accordance with claim **10** wherein said envelope provides an open layer for said gas with said first plane on one side of said layer and said second plane on the other side of said layer,

and said cells are defined entirely by said land areas,

whereby a matrix display panel having a multiplicity of character positions each capable of having a multiplicity of individually addressable character font elements is provided in a simple structure.

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