

[54] **GRAPHIC SYMBOL DISPLAY SYSTEM INCLUDING PLURAL STORAGE MEANS AND SHARED SIGNAL CONVERTER**

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[57] **ABSTRACT**

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A display system with a plurality of electric indicator devices having a plurality of circuits for memorizing binary digit signals supplied thereto, the number of such memorizing circuits corresponding to that of the indicator devices. Included is a circuit common to all the memorizing circuits for converting the memorized binary digit signals into code signals for display. Circuits are provided for applying the binary digit signals from each of the memorizing circuits to the converting circuit sequentially in a time divisional manner. A plurality of circuits is connected between the converting circuit and the indicator devices, respectively, each of the last-mentioned circuits being supplied with the code signals from the converting circuits in a time divisional manner to memorize them and to apply them to the respective indicator device. The system also includes a circuit for activating the indicator devices.

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[58] **Field of Search**.....340/336, 334, 324 R, 340/343, 168 SR; 315/84.6

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7 Claims, 5 Drawing Figures

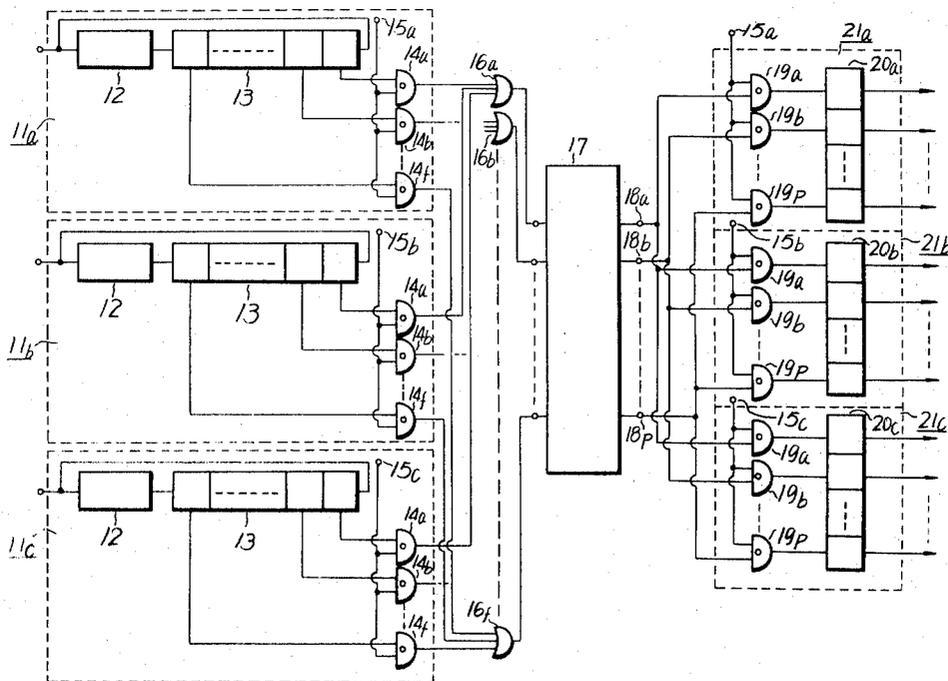


FIG. 1

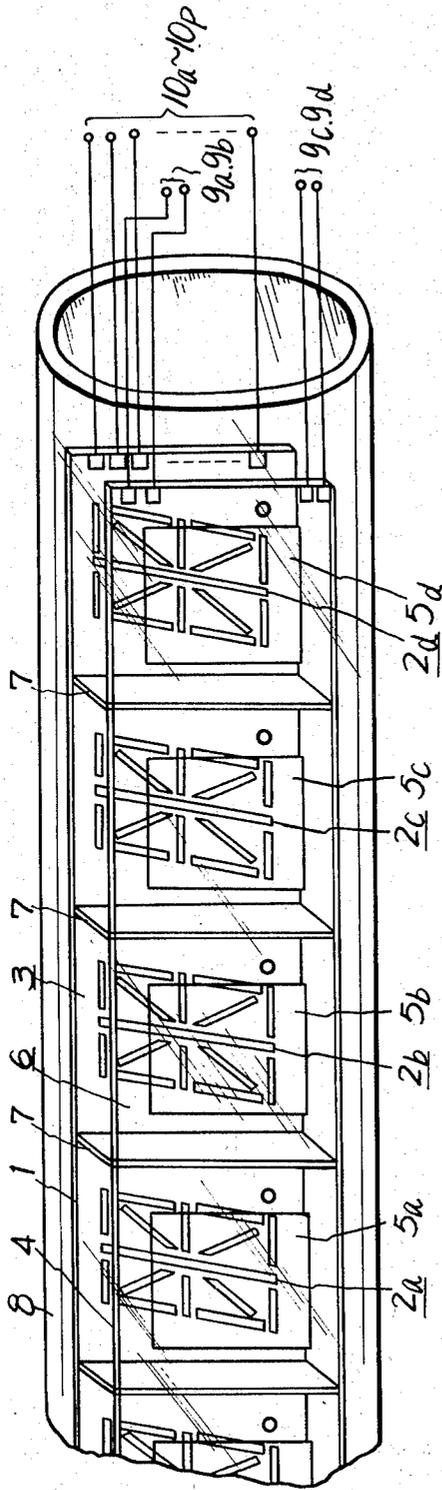
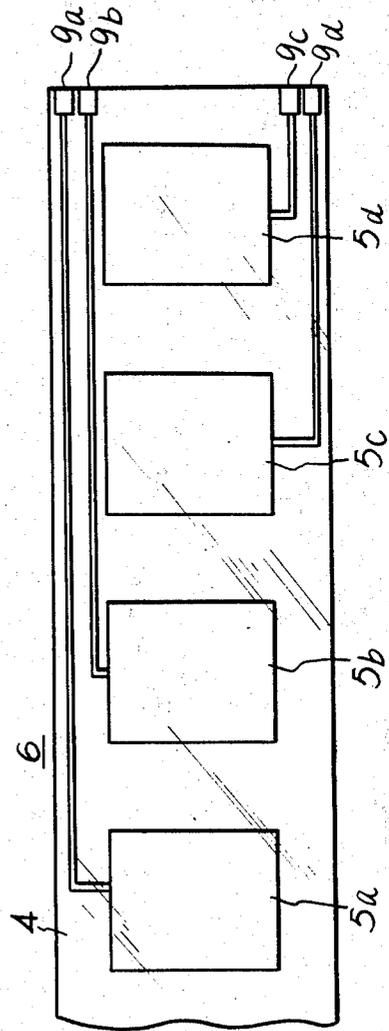
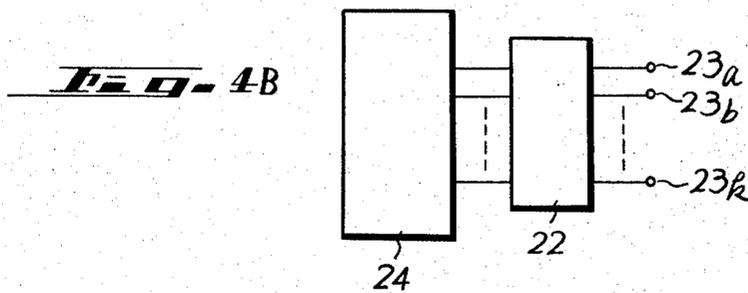
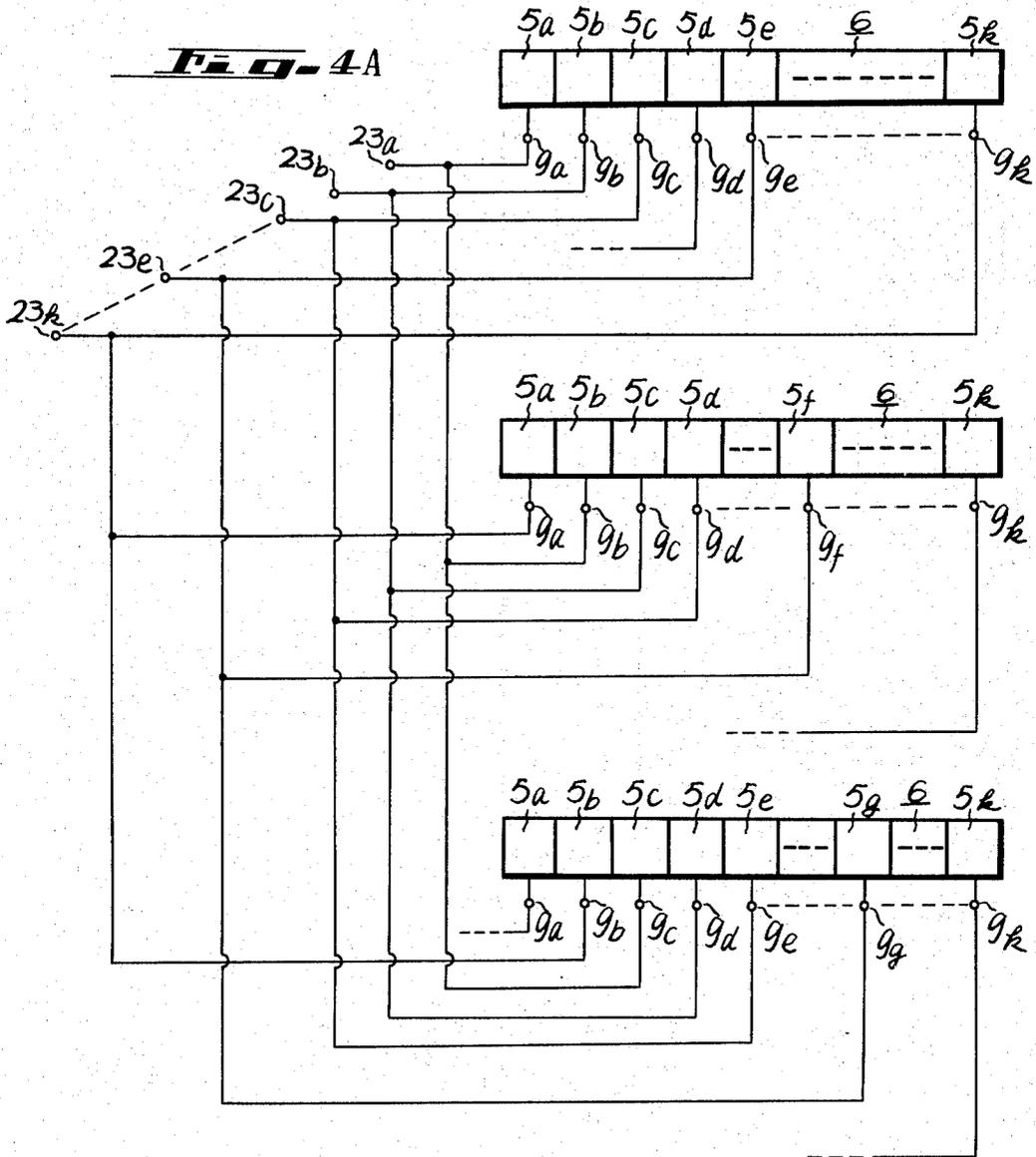


FIG. 2



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GRAPHIC SYMBOL DISPLAY SYSTEM INCLUDING PLURAL STORAGE MEANS AND SHARED SIGNAL CONVERTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to display systems using an electric indicator device, and more particularly to a simplified system for operating a plurality of gaseous glow indicator tubes or other indicator devices, for example, luminous semiconductor diode elements, forming a multi-unit, multi-row display.

2. Description of the Prior Art

In prior art display devices, in order to obtain a multi-row display with gaseous glow indicator tubes in which each row consists of a plurality of indicator units several decoders are provided, the number of which corresponds to the number of rows. An anode driver is also provided for the display tube. Accordingly, the prior art devices have the drawback that a number of decoders of complicated construction and high price are required in the event that a gaseous glow alpha-numeric indicator tube is employed which comprises a number of display units for displaying English letters, numerals or the like, all hereafter referred to as "figures." In the event that a plurality of rows are collected together as a single row and a plurality of rows with a plurality of figures are displayed, the brightness of the gaseous glow indicator tube is deteriorated and in addition flicker appears due to the increase of the number of figures.

SUMMARY OF THE INVENTION

One object of this invention is to provide a display system which is free from the drawbacks encountered in the prior art device.

Another object of this invention is to provide a display system which employs a plurality of indicator tubes or the like for displaying a plurality of rows and is simple in construction.

A further object of this invention is to provide a display system, in which a common decoder is provided for supplying signals to a plurality of indicator tubes or the like which display a number of rows to operate the indicator tubes in a time divisional manner.

A still further object of this invention is to provide a display system in which a common decoder for cathode signal supply and a common anode driver are provided for a plurality of gaseous glow indicator tubes or other indicator devices, for example, luminous semiconductor diode elements displaying a number of rows so as to operate the indicator tubes in a time divisional manner.

Other objects, features and advantages of this invention will be apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic perspective view of one example of gaseous glow indicator tubes which can be employed in the present invention;

FIG. 2 is a front view of a part of the gaseous glow indicator tube depicted in FIG. 1;

FIGS. 3, 4A and 4B are respectively block diagrams illustrating the main part of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In order to provide a clear explanation, this invention is described hereinafter with reference to an embodiment using plural gaseous glow indicator tubes as the indicator device. However, other display devices can also be used such as light-emitting diodes, commonly designated as L.E.D.'s.

FIG. 1 shows a gaseous glow indicator tube applicable to the present invention in which each figure, which may be a letter or a numeral, is displayed in a time divisional manner. The tube comprises an insulator board 1 made of glass, ceramic, or the like with electrode units 2a, 2b, 2c and 2d for four figures on one surface. Each electrode unit consists of 16 electrode elements formed by means of electrodeless deposition, electro deposition, photo-etching or a like method, although no single letter or number will utilize all 16 elements.

The electrode units 2a, 2b, 2c and 2d act together as a cathode 3. In this case the corresponding electrode elements of the respective electrode units 2a, 2b, 2c and 2d are connected together and then connected to 16 terminals 10a to 10p respectively. Reference numerals 5a, 5b, 5c and 5d represent electrodes each of which is provided in opposed relation to the electrode elements of each of the electrode units 2a to 2d. That is, each of the electrodes 5a to 5d is common to all the electrode elements of each of the respective electrode units 2a to 2d. The common electrodes 5a to 5d are transparent thin conductive layers made of tin oxide or the like on a transparent insulator plate 4 normally of glass but may be made of other materials. The electrodes 5a to 5d may be formed by photo-etching or otherwise removing unwanted areas of the thin conductive layers except at the positions corresponding to those of the respective electrode units 2a to 2d, as shown in FIG. 2. Reference numerals 9a to 9d indicate terminals to which the common electrodes 5a to 5d are respectively connected to form an anode 6. The cathode 3 and the anode 6 are assembled in such a manner that the electrode units 2a to 2d and the common electrodes 5a to 5d are juxtaposed and are spaced apart by a distance of about 2-5 mm. shield boards 7 made of insulating material, such as mica, are interposed between the adjacent electrode units 2a to 2d. After assembly, the electrodes 3 and 6 are then sealed in a glass tube 8 with a gas suitable for glow indication. From terminals 9a to 9d for anode drive and 16 terminals 10a to 10p for cathode drive extend from one end of the tube 8.

When this gaseous glow indicator tube is used, any one of the anode drive terminals 9a to 9d may be supplied with electric power E for anode drive. The cathode drive terminals 10a to 10p of the electrode elements corresponding to the letters or numerals to be displayed are selectively grounded to generate a glow discharge between appropriate segments of the cathode 3 and the anode 6 so as to display desired letters or numerals.

According to the present invention, a plurality of registers for display, a single decoder and a plurality of buffers for display are respectively provided for a time divisional system of plural rows. The registers, encoder, and buffers prepare code signals for display from bi-

nary digit signals memorized in the display registers through the decoder and apply the code signals to the plurality of display buffers in a time divisional manner to be stored therein. The code signals stored in the display buffers are displayed at the same time in a plurality of time divisional systems for plural rows by suitable means.

A detailed explanation will be made of one embodiment of this invention. In the present invention three gaseous glow indicator tubes are arranged in three rows for display of plural rows in a time divisional manner. Each of the three indicator tubes comprises 11 indicator electrode units for 11 figures, each of which has electrode units consisting of 16 electrode elements as explained above. In FIG. 3 reference numerals 11a, 11b and 11c represent display registers in correspondence with a first, a second and a third row. The display register 11a corresponding to the first row includes a shift register 12 and a shift register 13. It is to be noted here that the display register is formed with conventional arrangements so that the content in each of the digit portions of the register moves circularly therein. The former shift register 12 is of a bit length equal to or smaller than the figures of the gaseous glow indicator tube, for example, 11-bit length. The shift register 13 is of a bit length corresponding to the bit length of the code, for example, six-bit length. These shift registers 12 and 13 shift the code of binary digit signals written by a key in synchronism with clock pulses. The codes of six-bit length are respectively supplied to input terminals of six parallel AND-circuits 14a, 14b, . . . 14f from the shift register 13. The remaining input terminals of the AND-circuits 14a to 14f are connected together to a terminal 15a to which a read out signal is applied. The output terminals of the six AND-circuits 14a to 14f are connected to six input terminals of a decoder 17 through OR-circuits 16a to 16f respectively. The decoder 17 converts the binary digit signal codes supplied at its input terminals to the corresponding signals of 16-bit length for cathode drive. The display registers 11b and 11c corresponding to the second and third rows are respectively each constructed in the same manner to the display register 11a corresponding to the first row, so that the numerals corresponding to those of the register 11a designate the corresponding elements in the registers 11b and 11c. In this case, however, read out signals in synchronism with clock pulses are sequentially supplied to the respective terminals 15a, 15b and 15c of the display registers 11a, 11b and 11c so as to apply the binary digit signal codes of six-bit length written in the respective display registers 13 in a time divisional manner to the decoder 17.

Sixteen output terminals 18a to 18p of the decoder 17 corresponding to the 16 electrode elements of the gaseous glow indicator tubes are respectively connected to input terminals of 16 AND-circuits 19a to 19p of a buffer circuit or means 21a for the first row display. The other input terminals of the AND-circuits 19a to 19p are connected together and connected to the read out signal supply terminal 15a. The output terminals of the AND-circuits 19a to 19p are connected to a buffer 20a of 16-bit length. Other buffer circuits 21b and 21c for the second and third rows are constructed in a similar manner to the buffer circuit 21a for the first row. The cathode drive signals stored in the display

buffer circuits 21a, 21b and 21c are supplied through switching circuits (not shown) to the cathode drive terminals 10a to 10p (FIG. 1) of the gaseous glow indicator tube for each row and the electrode elements corresponding to the codes are selectively grounded. In order to drive the anodes for the first, second and third rows in a time divisional manner in the cathode drive device, a drive source 22 for the gaseous glow indicator tubes is provided in common to the anodes 6 of the first, second and third rows as shown in FIG. 4A and 4B. That is, in case that the common anode 5a in the first row, the common anode 5b in the second row and the common anode 5c in the third row are connected together, the common anodes in the respective rows are connected in shifted condition by one figure or digit to provide an anode drive terminal 23a. Similarly, 10 more anode drive terminals 23b to 23k are respectively provided. The anode drive terminals 23a to 23k thus formed are respectively connected to the output terminals of the anode drive source 22, whereby anode drive pulses are supplied to the anode drive terminals 23a to 23k. The pulse width of the anode drive pulses is determined by the time during which the codes corresponding to the letters or numerals to be displayed next shift the shift registers 12 and 13 and are newly stored in the display buffer circuits 21a, 21b and 21c of the cathode drive device and by the characteristics of the gaseous glow indicator tube itself. Further, the common anodes 5a to 5k the respective rows are drive in jump, for example, by three figures. For this purpose a timing circuit 24 is provided by which the anode drive source 22 is controlled.

A description will be given to the operation of the example of this invention the construction of which is explained just above.

Upon operation of a key (not shown), the binary digit signal code of six-bit length corresponding thereto is written in the display register 11a and is shifted to the shift register 13 of the display register 11a in synchronism with the clock pulse and stored therein. When the read out signal, the pulse width of which is equal to the time duration within which the code of six-bit length is shifted, is applied to the terminal 15a, the code from the shift register 13 is converted into the code of 16-bit length for the cathode drive and stored in the buffer 20a of the display buffer circuit 21a, whereby appropriate elements of the cathode 3 of the indicator tube for the first row are selected in correspondence with the letter or numeral for the first figure. Similarly, when the read out signals corresponding to the time of one shift are sequentially supplied to the terminals 15b and 15c the cathodes 3 of the second and third rows are similarly selected. In this case the cathode drive codes stored in the display buffer circuits 21b and 21c of the second and third rows are such that the code in the buffer circuit 21b corresponds to the letter or numeral of the second figure in the second row while the code in the buffer circuit 21c corresponds to the letter or numeral of the third figure. As explained above, after predetermined cathode drive codes are stored in all the display buffer circuits 21a, 21b and 21c for all the rows, the drive pulse from the anode drive source 22 which is controlled by the timing decoder 24 is supplied to the terminal 23a for anode drive. As a result the predetermined letters or numerals are dis-

played at the same time on the first figure in the first row, on the second figure in the second row and on the third figure in the third row, respectively. After different cathode drive codes are stored in the display buffer circuits **21a**, **21b** and **21c**, the anode drive pulse is applied through the anode drive terminal **23e** to the common electrode **5e** in the first row, the common electrode **5f** in the second row and the common electrode **5g** in the third row to achieve the predetermined display. In synchronism with the sequential storage of the codes in the display buffer circuits **21a**, **21b** and **21c** of the cathode drive device, the anode drive pulses are sequentially supplied to the terminals **23a** to **23k** to display all the figures of each row in a time divisional manner and in jump by three figures.

According to the present invention, since the decoder **17** is provided in common to all the rows, a display device of simple construction can be obtained suitable for plural row display, especially in the case where a gaseous glow indicator tube with a number of electrode elements is employed. The present invention has been found to operate with good results when the clock pulse of $2 \mu\text{sec.}$ and the anode drive pulse of $288 \mu\text{sec.}$ are used. It may be also possible that the number of rows used in the present invention can be more than 10 in accordance with the characteristics of gaseous glow display tubes employed therein and the speed of the shift of the registers used therein.

It will be apparent that many modifications and variations may be effected by those skilled in the art without departing from the scope of the novel concepts of the present invention.

We claim as our invention

1. A graphic symbol display system comprising:

A. a plurality of electric indicator devices;

B. a corresponding number of storage circuit means for storing a succession of binary digit signals supplied thereto each of said storage means comprising an output shift register;

C. converting means connected to all of said output shift registers to receive the binary digit signals in parallel from said shift registers and to convert said signals into code signals for actuating said indicator devices;

D. first gating means for applying the binary digit signals from each of said shift registers to said converting means sequentially in a time divisional manner;

E. additional gating means respectively connected between said converting means and each said indicator devices, each of said additional gating means being supplied with the code signals from the converting means in a time divisional manner to store them therein and applying them to the respective indicator device to set said respective device to display a graphic sign corresponding to the code signals received from said converting means; and

F. energizing means for activating said indicator devices sequentially in a time divisional manner to make visible the graphic symbol for which said in-

dicator device has been set.

2. A display system as claimed in claim 1 further comprising means for generating timing pulse signals and supplying said timing pulse signals to said first gating means for applying the binary digit signals to the converting means and to said additional gating means connected between said converting means and said indicator devices.

3. A display system as claimed in claim 2 in which said means for applying said binary digit signals comprises a plurality of AND-circuits connected to said plural memorizing circuit means to receive the binary digit signals therefrom and connected to said timing pulse generating means to be actuated by the timing pulse signals.

4. A display system as claimed in claim 2 in which said AND-circuits are connected in plural groups, the number of said groups corresponding to that of said storage circuit means.

5. A display system as claimed in claim 2, wherein said plurality of circuit means connected between said converting means and said indicator devices comprises a second plurality of AND-circuits connected to said converting means to be supplied with code signals therefrom and connected to said timing pulse generating means to be actuated thereby.

6. A display system comprising:

A. a plurality of gaseous glow indicator tubes, each comprising a plurality of indicator electrode units, each of said units comprising plural cathode electrodes and an anode electrode;

B. a plurality of storage circuit means for storing binary digit signals supplied thereto, the number of said storage circuit means corresponding to the number of said indicator tubes, each of said storage circuit means comprising an output shift register;

C. converting means connected to all of said shift registers to receive the binary digit signals therefrom in parallel to convert the binary digit signals into code signals for actuating said indicator electrode units;

D. first gating means to apply the binary digit signals sequentially in a time divisional manner from each of said shift registers to said converting means;

E. a plurality of display buffer circuits connected to receive the code signals from said converting means in a time divisional manner and each comprising means to store the code signals, each of said buffer circuits being connected to a respective one of said indicator tubes to supply the stored signals to said cathode electrodes therein; and

F. means for applying an operating voltage signal selectively to said anode electrodes to operate said indicator tubes in a time divisional manner.

7. A display system as claimed in claim 6 in which said means for applying operating voltage is connected to said anode electrodes to activate simultaneously one of said indicator units of each indicator tube, said one of said indicator units being located in a different relative position in each of said indicator tubes.

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