

[54] **COLD CATHODE DISCHARGE TYPE
DISPLAY DEVICE**

[75] Inventors: **Rentaro Sasaki; Akinori Watanabe,**
both of Takasaki; **Mamoru Ikegame,**
Tachikawa; **Tatsuo Ogasawara,**
Tokyo, all of Japan

[73] Assignees: **Oki Electric Industry Co., Ltd.;**
Okaya Electric Industry Co., Ltd.,
both of Tokyo, Japan

[22] Filed: **Oct. 26, 1973**

[21] Appl. No.: **409,851**

[30] **Foreign Application Priority Data**

Nov. 1, 1972 Japan..... 47-125411

[52] U.S. Cl..... 313/197; 313/220

[51] Int. Cl..... H01j 61/54

[58] Field of Search 313/197, 198, 188, 220,
313/109.5

[56]

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Primary Examiner—Alfred L. Brody
Assistant Examiner—Darwin R. Hostetter
Attorney, Agent, or Firm—Charles E. Pfund, Esq.

[57]

ABSTRACT

In a cold cathode discharge type display device wherein a cathode substrate, a starting electrode substrate and an anode substrate are laminated between upper and lower insulative substrates, the cathode substrate, the starting electrode substrate and the anode substrate are provided with aligned perforations acting as discharge cells, there is provided a deionization gap contiguous with the discharge cells.

2 Claims, 2 Drawing Figures

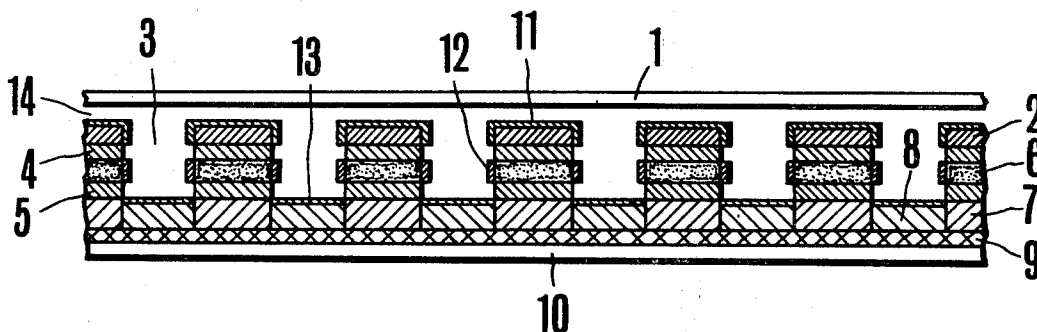


FIG. 1

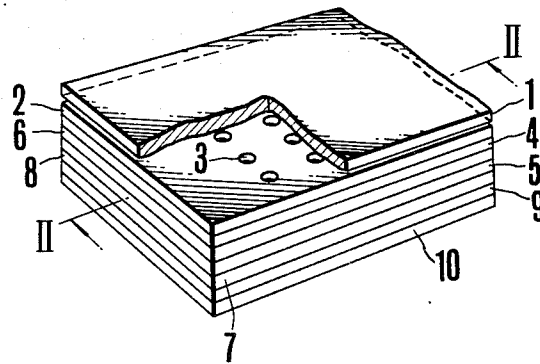
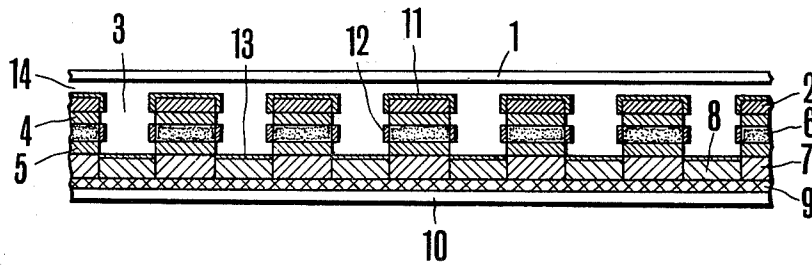


FIG. 2



COLD CATHODE DISCHARGE TYPE DISPLAY DEVICE

BACKGROUND OF THE INVENTION

This invention relates to a cold cathode discharge type display device wherein a definite space is provided above or beneath the anode or cathode electrode thereby enabling quick switching of the display of the desired patterns.

In the conventional cold cathode discharge type display device comprising a lamination of an anode electrode, a cathode electrode, spacers, a starting electrode and upper and lower substrates, display of a desired pattern is made by selectively operating discharge cells provided through the lamination. Since cations and secondary electrons formed in the discharge cell are extinguished by the upper and lower substrates it takes a certain time between the initiation of the discharge in the discharge cells which are selected on the time division basis and the completion of the display of a desired multi-digit pattern. For this reason, in order to display the patterns without giving the feeling of flickering to the eyes, it is necessary to increase the frequency of the time division signals for operating the display device. Furthermore, when the spacing between respective discharge cells is smaller than the spacing between the anode and cathode electrodes, adjacent discharge cells interfere with each other thereby causing discharge of not selected discharge cells.

SUMMARY OF THE INVENTION

It is an object of this invention to provide an improved cold cathode discharge type display device capable of eliminating the disadvantages described above.

Another object of this invention is to provide and improved cold cathode discharge type display device provided with a plurality of discharge cells which are operated selectively and sequentially and means for diffusing secondary electrons and cations remaining in a previously operated discharge cell thus displaying desired patterns at a high speed.

According to this invention, these and further objects can be accomplished by providing a cold cathode discharge type display device of the class wherein a cathode substrate, a starting electrode substrate, and an anode substrate are laminated between upper and lower insulative substrates, the cathode substrate, the starting electrode substrate and the anode substrate are provided with a plurality of sets of aligned perforations which are arranged in a plurality of matrixes, and the perforations act as discharge cells, characterized by a deionization gap contiguous with the discharge cells.

Preferably, the deionization gap is provided between the upper insulative substrate and the cathode substrate.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a perspective view, partly broken away, of a cold cathode discharge type display device embodying the invention, and

FIG. 2 shows a sectional view of the discharge device shown in FIG. 1 taken along a line II—II.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The cold cathode discharge type display device illus-

trated in FIG. 1 comprises an upper transparent insulative substrate 1 made of glass, for example, a cathode substrate 2 spaced a predetermined distance from the insulative substrate 1 and provided with a plurality of perforations 3 which are arranged in a plurality of similar matrixes, the surface of the cathode substrate 2 confronting the insulative substrate 1 and the inner walls of perforations 3 being plated with metal to form a cathode electrode, spacers 4 and 5 each provided with perforations 3 which are arranged in a plurality of matrixes, a starting electrode substrate 6 also provided with matrixes of perforations 3, the inner walls thereof being plated to form starting electrodes, an anode substrate 7 formed with a resistor 8 on the upper surface, the surface of the resistors confronting the starting electrode substrate 6 being plated with nickel, for example, to form anode electrodes, whereas the lower surface of the resistors 8 being covered by a thin sheet of an electric conductor 9 made of 42-6 alloy, for example, and a lower insulative substrate 10.

Various substrates are laminated as shown in FIG. 1 and the periphery of the lamination is sealed in an air tight fashion by means of fused glass. After evacuating the sealed assembly, inert gas such as neon or argon is sealed in the assembly to complete the cold cathode discharge type display device of this invention.

FIG. 2 shows a sectional view of the novel cold cathode discharge type display device in which 11 shows the cathode electrode, 12 starting electrodes, 13 anode electrodes, and 14 a deionization space or gap between the transparent insulative substrate 1 and the cathode electrode 11. Each set of aligned perforations 3 constitutes a discharge cell.

In operation, when a voltage higher than the discharge initiation voltage is impressed across the anode electrode 13 and the starting electrode 12 of a discharge cell selected by a matrix driving circuit, not shown, an electric discharge will be established between the anode electrode 13 and the starting electrode 12 of the selected discharge cell. After a predetermined interval the anode voltage is decreased to a value somewhat higher than the discharge sustaining voltage between the anode electrode 13 and the cathode electrode 11 thus shifting the discharge to between the anode and cathode electrodes 13 and 11 respectively. In this manner, the selected discharge cell is caused to luminesce. By selecting respective discharge cells on the time division basis, a desired pattern is displayed. As the selection time of one discharge cell elapses, the discharge thereof terminates but in the perforations 3 of that cell, secondary electrons and cations still remain. Although, a half selection voltage is impressed upon the discharge cell previously selected at the time of selecting the next discharge cell, in the novel cold cathode discharge type display device of this invention, the secondary electrons and anions remaining in the previously selected discharge cell are extinguished by diffusing into the deionization space 14 between the insulative substrate 1 and the cathode electrode 11 so that previously selected discharge cell would not be caused to discharge again by the half selection voltage.

In this manner, the deionization space or gap 14 prevents any interference between adjacent discharge cells so that it is possible to increase the frequency of the time division selection and to continuously display patterns at high speeds.

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It should be understood that instead of providing the gap between the transparent insulative substrate and the cathode electrode, similar gap can also be provided between the anode substrate 7 and spacer 5 to attain the same object.

What is claimed is:

1. In a cold cathode discharge type display device of the type wherein a cathode substrate, a starting electrode substrate and an anode substrate are laminated between upper and lower insulative substrates with said starting electrode substrate between said cathode and anode substrates, said cathode substrate, starting elec-

trode substrate and anode substrate are provided with a plurality of sets of aligned perforations which are arranged in a plurality of matrixes, and said perforations act as discharge cells, the improvement which comprises spacing means for one of said insulative substrates for forming a deionization gap area over said matrixes contiguous with said discharge cells.

2. The display device according to claim 1 wherein said upper insulative substrate is transparent and said deionization gap is provided between said upper insulative substrate and said cathode substrate.

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