

[54] COLD CATHODE DISCHARGE TYPE
DISPLAY APPARATUS WITH INTEGRAL
MEMORY

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

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

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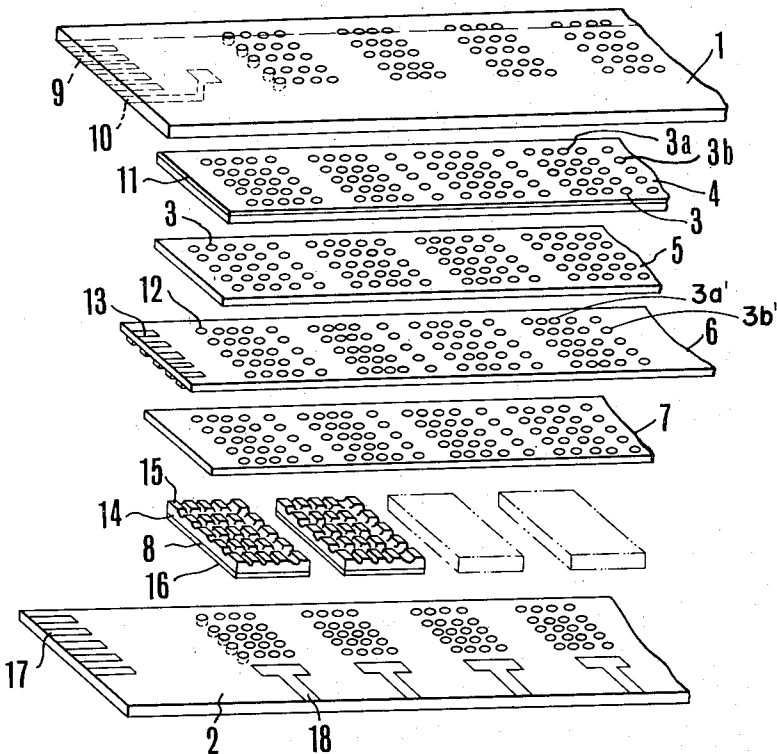
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Primary Examiner—John W. Caldwell
Assistant Examiner—Marshall M. Curtis
Attorney, Agent, or Firm—Dike, Bronstein, Roberts,
Cushman & Pfund

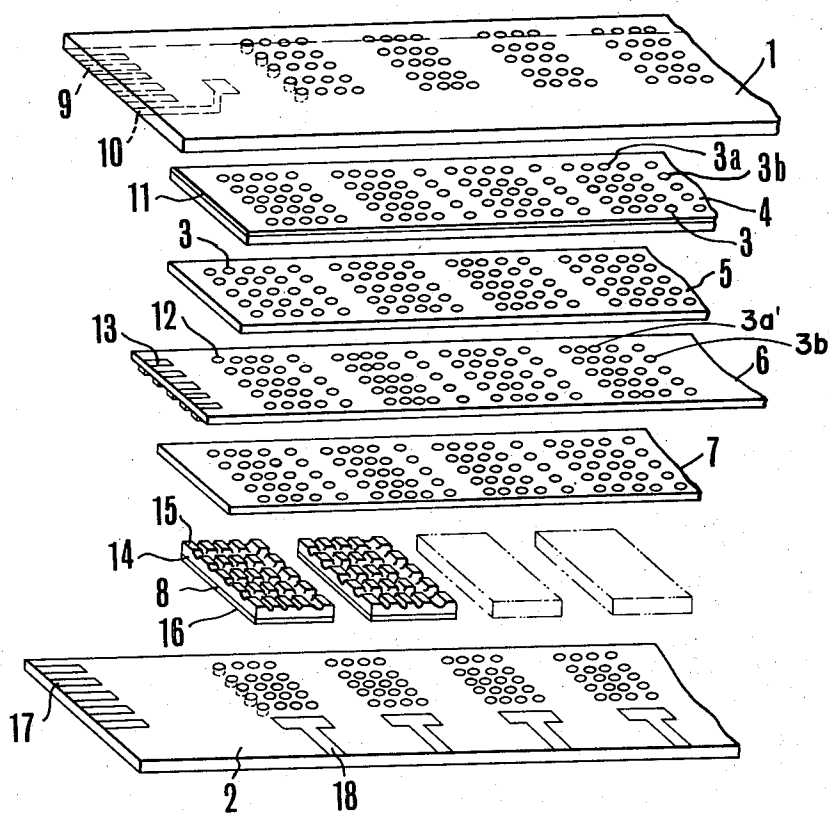
[57] **ABSTRACT**
In a cold cathode discharge type display apparatus of the type wherein letters are displayed by a plurality of display sections each including a group of discharge cells which are arranged in a matrix, there is provided an additional group of discharge cells which are disposed close to the group of discharge cells of each display section for storing a binary code of a letter subsequently to be displayed.

3 Claims, 1 Drawing Figure



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COLD CATHODE DISCHARGE TYPE DISPLAY APPARATUS WITH INTEGRAL MEMORY

BACKGROUND OF THE INVENTION

This invention relates to an improvement of a cold cathode discharge type display apparatus of the type wherein letters (including digits and symbols) are displayed by a plurality of display sections each including a group of discharge cells which are arranged in a matrix. In the display apparatus of the type referred to above, an input signal is converted into a signal containing a pattern information corresponding to a letter to be displayed on a display section by means of a matrix drive circuit. Binary codes representing respective letters are stored in a memory device disposed on the outside of the display apparatus and the matrix drive circuit is controlled by the binary codes stored in the external memory device. For this reason, the construction of the prior art display apparatus is complicated and expensive because it is necessary to install an independent memory device.

SUMMARY OF THE INVENTION

It is an object of this invention to provide a simplified cold cathode discharge type display apparatus by incorporating the memory device into the display apparatus itself. Since such memory device is formed by a group of discharge cells identical to the discharge cells of the display sections it is possible to greatly simplify the construction of the display apparatus.

According to this invention, there is provided a cold cathode discharge type display apparatus of the class wherein letters are displayed by a plurality of display sections each including a group of discharge cells which are arranged in a matrix, characterized in that there is provided an additional group of discharge cells which are disposed close to the group of discharge cells of each discharge section and that the additional group of discharge cells of each display section is used to store a binary code of a letter subsequently to be displayed.

BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, a single figure shows an exploded view of a cold cathode discharge type display apparatus embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The display apparatus illustrated in the accompanying drawing comprises an upper substrate 1 and a lower substrate 2. Between these substrates are disposed a cathode electrode substrate 4 provided with a plurality of groups of perforations 3, each group of perforations being arranged in a matrix to form a display section, a first spacer 5, a starting electrode plate 6, a second spacer 7 and a plurality of divided anode electrode substrates 8, one for each display section. Starting electrode terminals 9 connected to electrodes to be described later and a cathode terminal 10 are printed on the lower surface of the upper substrate 1 which faces to the cathode electrode substrate 4 on the opposite ends the upper substrate 1. The upper substrate 1 is formed with a plurality of groups of perforations which are aligned with the perforations 3 of the cathode electrode substrate 4. The cathode electrode substrate 4 is provided with a cathode electrode 11 formed by plating

the upper surface of the cathode electrode substrate 4 which faces to the lower surface of the upper substrate 1, a plurality of groups of perforations 3a for displaying letters and a plurality of groups of additional perforations 3b, each positioned on one side of each group of perforations 3a and adapted to store a five bit letter code. The starting electrode 6 is also provided with a plurality of groups of perforations 3a' and a plurality of groups of additional perforations 3b', each aligned with corresponding perforations of the upper substrate 1 and of the cathode electrode substrate 4. The inner wall of each perforation of the starting electrode plate 6 is provided with a through hole plating which is used as a starting electrode 12 connected to one of terminals 13 through a printed wire, not shown. Each anode substrates 8 comprises a resistance body 14. A plurality of projections corresponding to the respective perforations of the cathode electrode substrates 4 are formed on the upper surface of the resistance body 14 by means of a plurality of grooves intersecting with each other at right angles. An anode electrode 15 is formed on the top of each projection by nickel plating. A thin plate 16 of a 42-6 alloy, for example is bonded to the opposite surface of each resistance body 14. The lower substrate 2 made of insulator is provided with starting electrode terminals 17 on the opposite sides thereof which are adapted to be electrically connected to the terminals on the starting electrode substrate 6 and anode terminals 18 respectively engaging the thin plates 16.

Above described substrates and spacers are superposed one upon the other to form a lamination and the periphery thereof is sealed with frit glass or the like, not shown, thus forming a sealed envelope. The interior of the envelope is then evacuated and filled with such inert gas as neon, argon or the like to complete a cold cathode discharge type display apparatus.

This cold cathode discharge type display apparatus is constructed such that the breakdown voltage between the anode electrodes 15 and the cathode electrode 11 is higher than the breakdown voltage between the anode electrodes 15 and the starting electrodes 12 and that the discharge sustaining voltage between the anode electrode 15 and the cathode electrode 11 is lower than that between the anode electrodes 15 and the starting electrodes 12.

The above described cold cathode discharge type display apparatus operates as follows. An input signal is converted into a negative voltage by means of a matrix drive circuit and the negative voltage is impressed upon the starting electrode terminals 13 corresponding to the pattern information of the input signal. Then a voltage which is lower than the breakdown voltage between the anode electrodes 15 and the cathode electrode 11 but the sum of the first voltage and the voltage impressed upon the starting electrodes decreases to a value slightly higher than the breakdown voltage between the anode electrodes 15 and the starting electrodes 12 after a predetermined interval, is applied to particular one of the anode terminals 18. As a result, electric discharge will be established between the starting electrodes 12 and an anode electrode 15 connected to the particular anode terminal 18. Since a bias voltage higher than that between the anode electrode and the starting electrode is applied between the anode electrode and the cathode electrode, and as described above a voltage for the discharge sustaining voltage be-

tween the anode electrodes 15 and the cathode electrode 11 has been set to be lower than that between the anode electrodes 15 and the starting electrodes 12, said discharge will be transferred to between the anode electrode 15 and the cathode electrode 11. When the discharge transfers in this manner, the discharge current increases with the result that due to the voltage drop across the resistance plate 14, the anode voltage is decreased to a value near the discharge sustaining voltage between the anode and cathode electrodes, whereby the discharge is sustained between only the anode and cathode electrodes. With the construction described above the discharge transfers automatically from between the anode and starting electrodes to between the anode and cathode electrodes and thereafter this discharge is sustained irrespective of the condition of the input signal. The discharge is sustained at a display section including perforations 3a and such discharge can be observed as a predetermined pattern through the upper substrate 1. Perforations 3a constitute discharge cells and the input signal applied to the starting electrodes 13 functions to select the desired pattern. The anode voltage selects a display section.

As above described, according to this invention, adjacent each group of discharge cells which is used to display a pattern there is provided a group of additional discharge cells which are arranged on a column and used as a memory device. These additional discharge cells are formed by perforations 3b which comprise five bits in this example. These discharge cells are used to memorize the code of a pattern to be displayed subsequently in a display section with which they are associated. During discharge of the discharge cells, since the voltage across the anode and cathode electrodes is high or the discharge current between the anode and cathode electrodes increases it is possible to read the code by measuring the voltage or current of the discharge cell of each bit and the read out code is converted into a signal which is supplied to the above described matrix drive circuit. As above described, according to this invention, instead of utilizing a memory device which is normally located on the outside of the display apparatus, respective discharge cells of the code display section

tion 3b is used as the memory elements.

Although in the above described embodiment, the group of the discharge cells of each code display section is positioned on one side of an associated pattern display section, it will be clear that such group can also be disposed on the upper or lower side of the pattern display section.

What is claimed is:

1. In a cold cathode discharge type display apparatus of the class wherein letters are displayed by a plurality of display sections each including a group of discharge display cells which are arranged in a matrix, the improvement which comprises an additional group of discharge code cells which are disposed close to but whose discharge space is isolated from said group of discharge display cells of each display section, said additional discharge code cells of each display section being used to store a binary code of a letter subsequently to be displayed in said discharge display cells.

2. The cold cathode discharge type display apparatus as claimed in claim 1 wherein said additional discharge cells are arranged on a straight line along one side of the matrix of the discharge cells of a display section associated with said additional discharge cells.

3. The cold cathode discharge type display apparatus as claimed in claim 1 which comprises an upper substrate, a cathode substrate, a first spacer, a starting electrode, a second spacer, each provided with a plurality of groups of aligned perforations which are arranged in matrices, a plurality of anode electrodes one for each group of said perforations and a lower substrate, each group of aligned perforations of said upper substrate, said cathode substrate, said first spacer, said starting electrode, and said second spacer constituting discharge display cells of one letter display section, characterized in that an additional group of discharge code cells is provided for the group of discharge display cells of each letter display section, the discharge space of said code cells being isolated from said display cells, said additional group of discharge code cells being used to store a binary code of a letter subsequently to be displayed in said discharge display cells.

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