Nov. 14, ...

H. C. BORDEN, JR

3,702,723

SEGMENTED MASTER CHARACTER FOR ELECTRONIC DISPLAY APPARATUS

Filed April 23, 1971

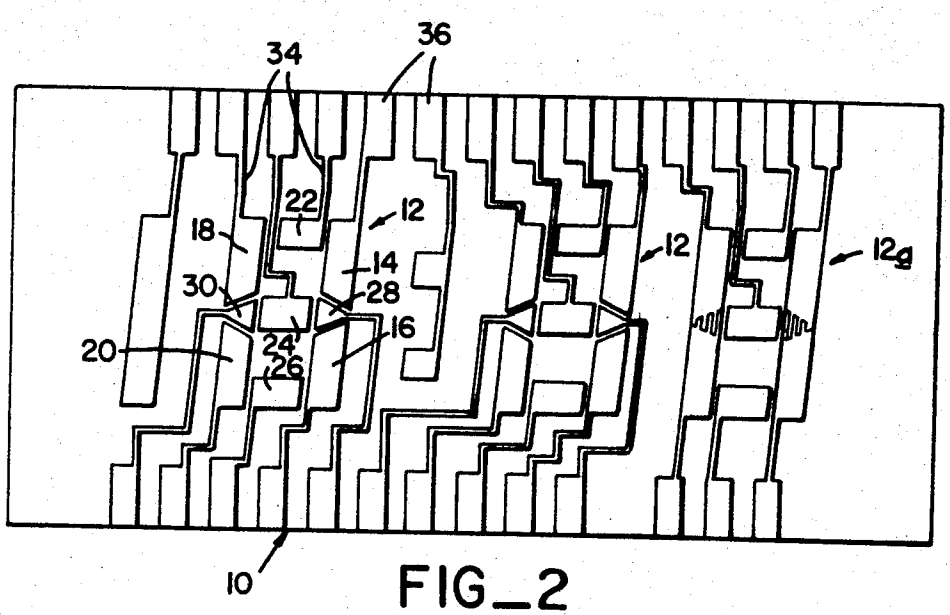


FIG_2

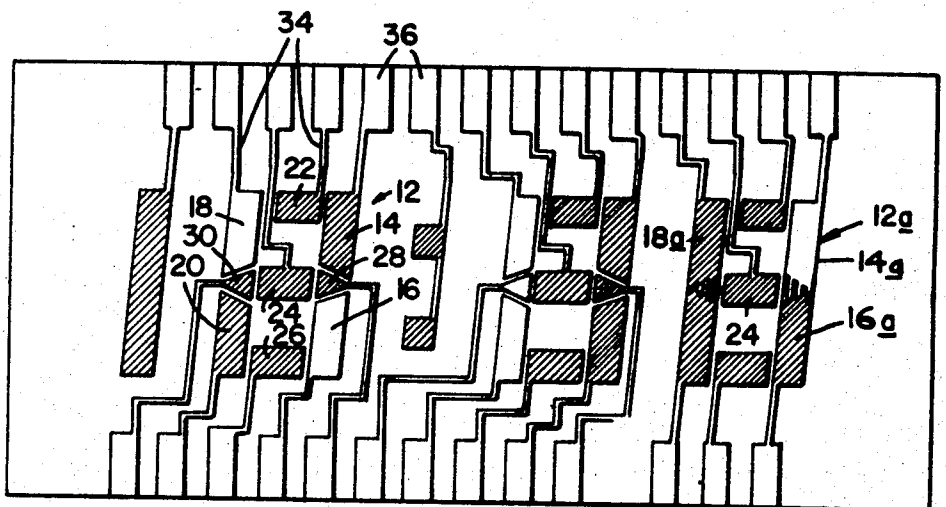


FIG_3

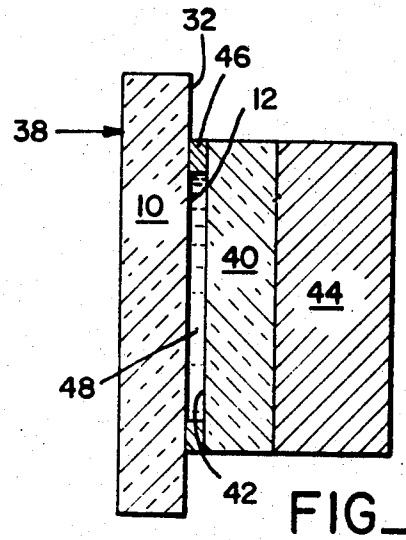


FIG_1

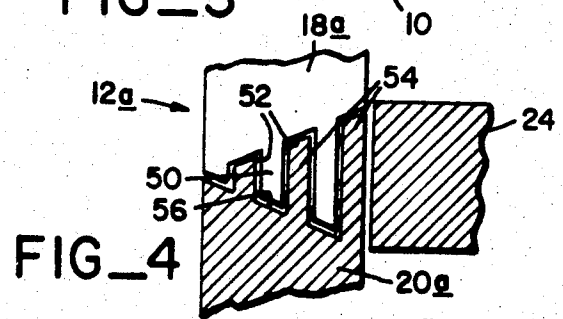


FIG_4

INVENTOR.
HOWARD C. BORDEN, JR.
BY
Owen, Wickersham & Erickson
ATTORNEYS

United States Patent Office 3,702,723 Patented Nov. 14, 1972

3,702,723

SEGMENTED MASTER CHARACTER FOR ELECTRONIC DISPLAY APPARATUS

Howard C. Borden, Jr., Atherton, Calif., assignor to American Micro-Systems, Inc., Santa Clara, Calif.

Filed Apr. 23, 1971, Ser. No. 136,829
Int. Cl. G09f 13/00
U.S. Cl. 350—160 LC 8 Claims

ABSTRACT OF THE DISCLOSURE

An improved highly readable character comprised of segments which can be energized in various combinations to define each of the arabic numerals in an electronic display apparatus. In one embodiment several characters are formed as thin film conductive members on the front plate of a liquid crystal display apparatus.

BACKGROUND OF THE INVENTION

This invention relates to electronic apparatus for displaying digital characters and more particularly to a unique multi-segment master character whose segments can be energized in various combinations to provide highly readable numeral characters.

Visual information readouts or displays have become an essential part of various electronic apparatus including relatively sophisticated computers or measuring devices and digital clocks. With all such readout displays a major problem was to provide characters with adequate readability characteristics and moreover character forming means having relative structural simplicity and functional reliability. The present invention solves this invention.

BRIEF STATEMENT OF THE INVENTION

The present invention provides a unique 8 or 9 segment master display character which will form highly readable and aesthetically pleasing numeric characters when various combinations of the segments are energized. The segments of the master character are shaped so that when energized in various combinations they form numerals having excellent definition without gaps between segments that heretofore made recognition difficult. Gaps at two junctions of various segments are eliminated by means of relatively small triangular segments that may be energized in various combinations with the other segments.

It is therefore one object of the present invention to provide an improved multi-segment master character for digital readout or display devices.

Another object of the present invention is to provide a multi-segment master character for readout or display devices that is adaptable for producing display characters that are particularly readable and aesthetically pleasing when utilizing all or some of the segments in various combinations.

Another object of the present invention is to provide a multi-segment master character that is particularly adaptable for use in a digital readout or display device utilizing the liquid crystal principle. In such a device a series of one or more of my master characters are formed by a deposition process on a glass plate. Lead members extend from the various segments to contacts or bonding pads spaced along the edges of the plate. Electrical signals furnished to the pads cause the segments of each master character to be energized in the desired combinations to thereby produce visually readable numerals, such as on a digital clock.

Other objects, advantages and features of the invention will become apparent from the following detailed description of one embodiment thereof, presented in conjunction with the accompanying drawings:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in section of a liquid crystal display device utilizing a plate with stylized master characters according to the present invention;

FIG. 2 is an enlarged plan view of the front plate for the display device of FIG. 1 showing a series of master characters;

FIG. 3 is a view similar to FIG. 1 showing the front plate with the master characters energized to display a visual readout; and

FIG. 4 is an enlarged fragmentary view of a modified form of my master character.

DESCRIPTION OF ONE EMBODIMENT

In FIG. 2 is shown a transparent front plate **10** of a typical visual display or readout device having a series of identical, spaced-apart, segmented master characters **12** embodying the principles of the present invention. Each of these characters comprises nine segments formed by areas of a deposition layer of a transparent conductive material on the plate **10**, which are separated by narrow areas of no deposition. These include a first aligned pair of segments **14** and **16**, and a second similar pair of aligned segments **18** and **20** that are parallel but spaced apart from the first pair. Three spaced apart horizontal segments **22**, **24** and **26** extend between the pairs of vertical segments at various levels. At their junction the vertical segments **14** and **16** on one side are each beveled at an angle (e.g. 45°) to form a triangular gap within which is situated a slightly smaller triangular segment **28**. The vertical segments **18** and **20** are similarly beveled at their adjacent ends to form a similar triangular gap within which is a triangular segment **30**. Thus, when all of the nine segments are viewed together the master character **12** has the appearance of a complete numeral 8 in a highly readable form.

In the embodiment shown, three master characters according to my invention are arranged at spaced apart locations and with "one" and "colon" characters on the front plate **10** which may be glass or clear plastic for use as a digital clock display. However, it should be apparent that other types of digital display devices could utilize one or more master characters according to my invention. Each master character with its separate and distinct segments may be formed of any suitable transparent conductive material which can be applied as by a deposition process to the inner surface **32** of the plate **10**. Attached to and extending along the surface from each segment is a lead member **34** and these members terminate at bonding pads **36** spaced along an edge of the display plate. The lead members are rendered invisible by elimination of the electric field in these selective areas. To the pads **36** may be connected the various leads from a signal supplying control circuit of whatever apparatus the displayer is used on.

In FIG. 1 is shown schematically a typical display device **38** which can utilize the front plate **10** with its series of spaced apart master characters **12** to provide a digital clock readout. In this arrangement for a so-called liquid crystal type display unit the front plate **10** is installed adjacent and parallel to another rear plate **40**. This rear plate is also made of glass or a clear plastic and has a uniform coating **42** of a transparent conductive material on its outer surface. Preferably, this rear plate is fixed to an opaque mounting fixture **44** such as an epoxy light sink. The two plates **10** and **40** are held apart a small distance by a peripheral sealing member **46** such as a plastic or structural glue which retains a quantity of a transparent organic liquid commonly referred to as "liquid crystal" **48**. This liquid has a molecular structure that is disoriented when a voltage is applied across it so that light is reflected in any area of disorientation. Thus, in the ar-

rangement shown in FIG. 1, light shining through the front glass plate **10** passes through the plate **40** and is absorbed by the rear opaque fixture **44**. Whenever any segment of a master character **12** is supplied with an electrical signal so as to produce a voltage across the liquid at that location, the segment will be energized to reflect or diffuse light and thus become visible to the human eye.

It will be seen that, for each master character energizing all segments in the aforesaid manner will produce a perfect figure eight. For any numeral from 0 to 9 the triangular segment **28** will always be energized, but the other triangular segment **30** is used only for the numerals 0, 4, 5, 6, 8 and 9.

In FIG. 3 the front plate **10** is shown with portions of its four master characters darkened in to illustrate the operation of the display when the time is 12:36. As shown, each numeral when formed is clear, distinct and aesthetically pleasing to the eye due largely to the triangular segments **28** and **30**.

A modified version of my master character, designated **12***a* is shown on the right end of the group of characters in FIGS. 2 and 3 and in greater detail in FIG. 4. Here, vertical portions **18***a* and **20***a* are configured at their adjacent end portions so as to eliminate the need for the triangular portion **30**. This simplifies the character because it also eliminates the associated input leads for the triangular portions **28** and **30** and the attached pads on the plate **10**, as well as the logic circuitry necessary to activate each triangular portion. As seen, each vertical portion **18***a* has spaced apart finger-like extensions **50** that are separated by slightly wider gaps **52** and extend downwardly from its sloped lower edge, terminating along a line parallel to the oppositely sloped edge of the lower character portion **20***a*. The lower character portion **20***a* is provided with similar finger-like extensions **54** on its sloped upper edge which are separated by slots **56** and which terminate along a sloped line parallel to the sloped edge of the portion **18***a*. The finger-like extensions **52** and **54** of the two character portions **18***a* and **20***a* interdigitate, so that when both of these portions are energized, a substantially solid vertical bar appears. In a similar manner the same finger-like arrangement may be provided for the vertical portions **14***a* and **16***a*. When any of the vertical character portions are energized separately in combination with the middle horizontal bar **24** its finger-like extensions **54** serve to fill the gap between the vertical and horizontal portions in much the same manner as the triangular portion **28** and **30** used in the previous character embodiment **12**. The result is an aesthetically pleasing and easily readable character representation.

To those skilled in the art to which this invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the spirit and scope of the invention. The disclosures and the description herein are purely illustrative and are not intended to be in any sense limiting.

I claim:

1. In a visual display device, a segmented master character electrode comprising:

upper, lower and middle segments of equal length extending horizontally and spaced vertically apart;

a first pair of generally vertical right and left segments extending downwardly from the opposite ends of said upper segment, each having a lower angular end edge, a second pair of generally vertical right and left segments extending upwardly from the ends of said lower segment each being aligned with a said downwardly extending segment and having an upper angular end edge;

said aligned upper and lower generally vertical segments being vertically spaced apart and forming a triangular gap at each end of said middle segment, the base portion of said triangular gap positioned closest to said middle segment; and

means for forming character portions located within said triangular gaps, said means for forming character portions within said triangular gaps comprising a plurality of finger-like extensions extending downwardly from the lower end of at least one of the vertical segments of said upper pair and forming a part of said vertical segment, and a plurality of similar finger-like extensions extending upwardly from the upper end of at least one of the vertical segments of said lower pair and forming a part of said vertical segment, said finger-like extensions interdigitating to fill substantially the entire area of the triangular gap etween said upper and lower vertical segments.

2. The display device as described in claim **1** wherein said display device comprises a transparent front plate, said segments forming said master characters each comprising a layer of transparent, conductive material on said front plate, lead portions connected to and extending from said segments to an edge of said plate and a rear plate positioned adjacent said segments and opposite said front plate, said rear plate providing a light sink.

3. A display device as set forth in claim **1** wherein each of said upper pair of vertical segments includes said extensions and each of said lower pair of vertical segments includes said extensions.

4. A display device as set forth in claim **2** wherein each of said upper pair of vertical segments includes said extensions and each of said lower pair of vertical segments includes said extensions.

5. A display device as set forth in claim **1** further including means associated with each of said segments to selectively energize said segments.

6. A display device as set forth in claim **2** further including means associated with each of said segments to selectively energize said segments.

7. A display device as set forth in claim **3** further including means associated with each of said segments to selectively energize said segments.

8. A display device as set forth in claim **4** further including means associated with each of said segments to selectively energize said segments.

References Cited

UNITED STATES PATENTS

3,505,804	4/1970	Hofstein	350—160
3,500,392	3/1970	Maljuk et al.	313—109.5
2,137,360	11/1938	Skelsey	40—130 E
3,504,214	3/1970	Lake et al.	313—109.5
3,187,320	6/1965	Kupsky	313—109.5
2,426,079	8/1947	Bliss	40—28 C
3,290,531	12/1966	Rychlewski	313—109.5

FOREIGN PATENTS

855,391	11/1970	Canada	313—109.5

RONALD L. WIBERT, Primary Examiner

J. ROTHENBERG, Assistant Examiner

U.S. Cl. X.R.

40—28 C, 130 E; 313—109.5