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PATENT SPECIFICATION

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(54) SEGMENT PATTERN FOR ALPHA-NUMERIC DISPLAYS

(71) We, TIMEX CORPORATION, a Corporation organized under the Laws of the State of Delaware, United States of America, of Waterbury, Connecticut 06720, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an alpha-numeric electro-optical display device.

In recent years digital wristwatches, based on the use of electro-optical display devices, have been suggested which would also present calendar information.

Various types of electro-optical displays are widely employed for presenting patterns of numbers and letters. However, the electro-optical displays which have been suggested to present calendar information on a wristwatch, and particularly those which utilize a liquid crystal, electrochromic or light-emitting diode display, typically employ a plurality of seven-segmented characters in the form of a figure "8" to display the time in a digital format and separate indicia to represent the days of the week. With all such readout displays, however, major problems exist to provide characters with adequate readability characteristics and moreover character forming means having relative structural simplicity, functional reliability and character symmetry.

And, because it is vital to conserve power, it is necessary to minimize the size of the wristwatch display, and particularly, to minimize the number of separate display elements or indicia. Consequently, a display system having separate indicia or letters or many elements to display the calendar information requires an inordinately large area on the display and, therefore, is extremely inconvenient, expensive and generally undesirable considering the limitation on the amount of space on the wristwatch display, the numerous connecting leads required to the display and because it is extravagant of power. The present invention seeks to solve these problems.

Accordingly, an object of the present invention is to provide an improved electro-optical display. 50

A further object of the present invention is to provide an improved segment pattern arrangement for an electro-optical display.

Another object of the present invention is to provide an improved segment pattern arrangement for an electro-optical display for showing alpha-numeric information. 55

According to the present invention there is provided an alpha-numeric electro-optical display device comprising at least a first and a second character display each formed by three substantially horizontal and four substantially vertical discrete and elongated segments arranged essentially in a figure "8" for showing any single digit from 0 to 9, and two elongate elements each longitudinally aligned with one of said upper and lowermost horizontal segments of at least said first character, said segments and said elements being selectively actuatable for forming letters of the alphabet and/or digits. 60 65 70

A typical preferred display device of the invention comprises at least two characters each formed by three horizontal and four vertical discrete segments arranged generally in the form of a figure "8". The horizontal segments are positioned to form a top, centre and bottom portion of each character. The four vertical segments are positioned to form two discrete right and two discrete left side portions of each character. At least two discrete and generally elongated additional segments are positioned between said two characters with each of the two added segments being aligned substantially longitudinally, one with the top segment portion and the other with the bottom segment portion of at least one of said two characters. The addition of two segments between the two (seven-segmented) digits makes it possible to present alpha-numeric information, namely, the first two letters of each of the days of the week. The added segments are so positioned in relation to the digits that they can be used in the formation of a plurality of letters which 75 80 85 90 95

have improved symmetry to each other and position on the display, particularly on a liquid crystal wristwatch display.

The electro-optical display of the present invention provides segments which exhibit improved character position on the display and/or size and/or character configuration and symmetry, and is particularly suitable for showing alpha-numeric information on an electro-optical display wristwatch.

The above and further preferred features and advantages of the present invention will be apparent from the following detailed description of preferred embodiments thereof, reference being had to the accompanying drawings in which:—

Figure 1 illustrates an exemplary pattern of conductive character segments in a display device in accordance with the invention;

Figure 2 illustrates a few alphabet characters, particularly letters representative of each day of the week, that may be formed by the character pattern Figure 1;

Figures 3, 4 and 5 illustrate respective modified versions of the pattern of conductive character segments shown in Figure 1; and

Figure 6 is an exploded pictorial representation of basic elements of a display panel embodying a character pattern of the present invention.

Although the segmented character pattern described herein is specifically adapted for use in a liquid crystal display, the segment pattern also has application in light-emitting diode (LED) and electrochromic (EC) displays.

Figure 1 illustrates one embodiment of the invention which utilizes three and one-half digit display as has been used in recent years to display time in a digital format on a wristwatch. The digit display shown comprises a typical digit pattern 1, 2, 3, 4 of conductive segments on the inner surface of a front plate of an electro-optical display panel. Each of the digits 1, 2 and 3 is formed by three horizontal segment portions *a*, *g*, *d*

and four vertical segment portions *b*, *c*, *e*, *f* (subscript numerals 1, 2, 3 associated with the segments *a* to *g* are used to designate the particular digit that the segment is a part of) arranged in the form of a figure "8". By energization of the appropriate electrode segments, for example *a*, *b*, *g*, *e* and *d* to display the numeral 2, the numerals 0 to 9 can be presented on each of the digits 1, 2, 3. Since the order or combination of segments, of a seven-segmented digit, which are energized to display the numerals 0 to 9 are well known in the display art field, no further explanation thereof will be provided herein. Segment 4 is used to represent ten hours on a zero to twelve hour digital display and segments *M*₁, *M*₂ as a colon between the unit hours digit 1 and the tens of minutes digit 2.

For display of alphabet characters, two additional generally elongate segments *X*, *Y* are positioned between the tens of minutes digit 2 and the unit hours digit 1. The two added segments *X* and *Y* are longitudinally aligned with the top and bottom segment portions *a*₁, *a*₂ and *d*₁, *d*₂, respectively. The two added segments *X* and *Y* are configured and positioned between the two digits 1 and 2 so that the alphabet characters which may be formed by the activation of selected segments have symmetrical segment positioning and size. For example, segment *X* is positioned with respect to the tens of minute digit 2 such that by selective activation of the segments *X*, *f*₂, *e*₂, *a*₂ the alphabet character *T* is displayed having substantially symmetrical top segment portions *X* and *a*₂. Similarly, by activation of segments *b*₁, *c*₁, *y*, *e*₂, *f*₂, *d*₂, *c*₂ and *b*₂ the letter *W* is displayed which has substantially symmetrical bottom segment portions *Y* and *d*₂.

The following table is provided, in conjunction with Figures 1 and 2, to show the segments to be actuated for displaying particular alphabet characters, in particular letters representative of the days of the week:—

DAY	SEGMENT ACTIVATED (see Figures 1 and 2)
MONDAY	M: b1, c1, x, f2, e2, a2, b2, c2 O: a3, b3, c3, d3, e3, f3
TUESDAY	T: x, f2, e2, a2 U: b3, c3, d3, e3, f3
WEDNESDAY	W: b1, c1, y, e2, f2, d2, c2, b2 E: a3, f3, g3, e3, d3
THURSDAY	T: x, f2, e2, a2 H: b3, c3, e3, f3, g3
FRIDAY	F: a2, f2, g2, e2
SATURDAY	S: a2, f2, g2, c2, d2 A: a3, b3, c3, e3, f3, g3
SUNDAY	S: a2, f2, g2, c2, d2 U: b3, c3, d3, e3, f3

5 The display described, which utilizes two selectively energizable segments interpositioned between two digits, produces alphabet characters which are more legible than those of the prior art, which have improved symmetry and positioning on the display and, therefore, result in a generally more pleasing display.

10 The second embodiment of the invention which is shown in Figure 3 is similar to the embodiment of the invention shown in Figure 1 in that two discrete segments X, Y are positioned between the unit hours digit 1 and the tens of minute digit 2. However, this embodiment differs in that the conventional colon segments M₁, M₂ shown in Figure 1 are eliminated from the display and the segments X, Y are used during the standard time display of hours and minutes as, for example, a flashing colon between the hours and minutes digits and during the display of the day of the week as segments of the alphabet character(s) representative thereof.

20 With reference to Figure 4, another embodiment of the invention is shown. The added segments X₁₀, Y₁₀ in this embodiment function in a similar manner to the segments X,

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Y shown in Figure 1, to form the letters illustrated in Figure 2, with the exception that the segments X₁₀, Y₁₀ are positioned between the hour digits 1 and 4 and, therefore, the positioning of the letters on the display is changed with respect to the positioning of the letters that are formed by the segment pattern shown in Figure 1.

30 Referring now to Figure 5, another embodiment of the invention is shown which is similar to the one shown in Figure 4 in that the two added segments X₁₀, Y₁₀ are positioned between the hour digits 1 and 4. However, this embodiment differs in that the conventional colon segments M₁, M₂, shown in Figures 1 and 4, are replaced by a stylized figure such as, for example, a generally U-shaped segment M which is utilized as a flashing colon during the standard hour and minutes time display and as the letter U in conjunction with the letters T and S (formed by selected segments of the hour digit 1 and the added segments X₁₀, Y₁₀) to represent the day of the week—Tuesday and Sunday respectively. Thus, it is envisaged that the days of the week, except for Tuesday and

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1A

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Sunday, would be represented in accordance with this embodiment of the invention as a single letter presented by selected actuation of segments of the hour digits 1, 4 and segments X_{10} , Y_{10} .

Reference will now be made to Figure 6, in which is shown an exploded view of a display having a segment pattern in accordance with the invention. A lower substrate 20 has conductive segment or counter electrode elements 21 formed on the interior surface thereof connectable to external driving circuitry, for example, via lead 22. The driving circuitry (not shown) generally consists of an oscillator which generates a time standard frequency, a divider and a decoder-driver which drives the display. This type of circuitry is shown in considerable detail in many sources. Specific examples are United States Patents No. 3,953,964 and 3,754,392. It should be noted that, with appropriate modification, such modification being well known, the circuitry is also appropriate for use with light-emitting diodes and electrochromic as well as liquid crystal displays. Sandwiched between the upper 23 and lower 20 substrates is a gasket-like member 24. In the assembled state the space between the substrates formed by the gasket member 24 is filled either with a liquid crystal material when forming a liquid crystal display or an electrolyte when forming an electrochromic display. A light-emitting diode display would not require the lower substrate 20 or gasket-like member 24.

Since the details of the construction of liquid crystal, electrochromic and light-emitting diode displays are shown in considerable detail in many sources, exhaustive details thereof are omitted to avoid prolixity. Specific examples are United States Patents 3,908,355; 3,950,078; 3,944,333; 3,925,690 and 3,936,694.

WHAT WE CLAIM IS:—

1. An alpha-numeric electro-optic display device comprising at least a first and a second character display each formed by three substantially horizontal and four substantially vertical discrete and elongated segments arranged essentially in a figure "8" for show-

ing any single digit from 0 to 9, and two elongate elements each longitudinally aligned with one of said upper and lowermost horizontal segments of at least said first character, said segments and said elements being selectively actuatable for forming letters of the alphabet and/or digits.

2. A display device according to Claim 1, wherein said two elements are substantially equal in size and shape with said upper and lower horizontal segments respectively of said first and second characters and are disposed between said first and second characters, said first and second character segments and said first and second elements being selectively actuated by electric circuitry connected with said segments and elements for forming letters of the alphabet.

3. A display device according to Claim 2, wherein said circuitry is further adapted to selectively actuate said first and second elements for forming a colon indicium.

4. A display device according to Claim 1, wherein said two elements are substantially equal in size and shape with said upper and lower horizontal segments respectively of said first and second characters and are juxtaposed to a left side of said first character.

5. A display device according to Claim 4, including a third additional selectively actuatable element having a substantially letter U configuration juxtaposed to a right side of said first character.

6. A display device according to any one of the preceding claims, wherein said display is a liquid crystal device.

7. A display device according to any one of the preceding claims, wherein said display is an electrochromic device.

8. A display device according to any one of the preceding claims, wherein said display is a light-emitting diode device.

9. An electro-optic display device substantially as hereinbefore described with reference to the accompanying drawings.

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2. A display device according to Claim 1, wherein said two elements are substantially equal in size and shape with said upper and lower horizontal segments respectively of said first and second characters and are disposed between said first and second characters, said first and second character segments and said first and second elements being selectively actuated by electric circuitry connected with said segments and elements for forming letters of the alphabet.

3. A display device according to Claim 2, wherein said circuitry is further adapted to selectively actuate said first and second elements for forming a colon indicium.

4. A display device according to Claim 1, wherein said two elements are substantially equal in size and shape with said upper and lower horizontal segments respectively of said first and second characters and are juxtaposed to a left side of said first character.

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