

PATENT SPECIFICATION

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(54) A DISPLAY DEVICE

(71) We, KABUSHIKI KAISHA DAINI SEIKOSHA, a Japanese Company of 31-1, 6-chome, Kameido, Koto-ku, Tokyo, Japan, 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:—

This invention relates to display devices e.g. for electronic watches.

According to one aspect of the present invention there is provided a display device comprising two electrode plates on each of which is formed a plurality of individually energisable electrode segments and a third electrode plate on which is formed a common electrode, the said electrode plates being separated by an electrically insulating layer, and a liquid crystal material is disposed between one of said two electrode plates and the third electrode plate, the electrode segments overlapping when the display device is viewed in plan.

The display device, in a preferred embodiment, is arranged to display the symbols SUN, MON, TUE, WED, THU, FRI and SAT.

According to a further aspect of the present invention there is provided an electronic watch including a display device as recited above.

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:—

Figures 1 and 2 illustrate constructions of conventional display devices;

Figure 3 is a cross-section of one embodiment of a display device according to the present invention;

Figure 4 illustrates in detail part of the display device of Figure 3;

and

Figure 5 illustrates a second embodiment of a display device according to the present invention.

Referring to figure 1 there is illustrated a conventional display device comprising four

seven-segmented display units. Characters or numerals may be displayed by energising one or more segments of each display unit. However, the segments of each display unit are disposed in the same plane so that the display of characters and numerals have an unnatural and mechanical appearance.

One way of eliminating this difficulty is to provide a plurality of stacked or superimposed electrode plates each bearing an electrode in the form of a character or numeral, a display being produced by energising a given electrode plate. Such an arrangement is illustrated in Figure 2. Whilst this arrangement gives a natural appearance to the display characters and numerals, a relatively large number of electrode plates are necessary because one electrode plate cannot be used to form the display or part of the display of a number of different characters and numerals. Thus this arrangement cannot be made of a small size and employable in a small-sized electronic watch.

A display device according to the present invention is illustrated in Figure 3 and comprises an upper polarizing plate 1 mounted adjacent to a first electrode plate 2 on which a first electrode group 3 is formed. A second electrode plate 6 having a second electrode group 5 thereon is mounted adjacent to the first electrode plate 2 with a transparent electrically insulating layer 4 therebetween. A third electrode plate 8 having a common electrode 7 thereon is mounted adjacent the second electrode plate 6. A liquid crystal material 9 is inserted between the second electrode plate 6 and the third electrode plate 8. A polarizing plate 10 is disposed adjacent to the third electrode plate 8 and a reflecting plate 11 is disposed adjacent to polarizing plate 10. The display of the letters M, N, O and T will now be described. As shown in Figure 4, the first electrode group is composed of segments *a, b, c, f, g, h* printed on the first plate 2. The second electrode group 5 is composed of segments *e, d* printed on the second electrode

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5 plate 6. The first electrode plates 2 and the second electrode 6 are superimposed or stacked one above the other and the segments *b* and *d*, *b* and *e*, *e* and *g*, and *e* and *f* etc., overlap when the display device is viewed in play. However, the layer 4 between the first electrode plate 2 and the second electrode plate 6 prevents short circuiting. The letter M is displayed by energising the segments *a*, *b*, *c*, *h* and the common electrode 7. The letter T is displayed by energising the segments *d*, *e* and the common electrode 7.

10 The letter O is displayed by energising the segments *a*, *d*, *c*, *g* and the common electrode 7. The letter N is displayed by energising the segments *a*, *b*, *f*, *c* and the common electrode 7.

15 Referring now to Figure 5, there is illustrated another embodiment of a display device according to the present invention capable of displaying the symbols SUN, MON, TUE, WED, THU, FRI and SAT representing the days of the week. This display device has first second and third electrode plates 20, 21, 22 on each of which is printed an electrode group 25 in the form illustrated. By selectively energising segments of electrode groups together with a common electrode formed upon a common electrode plate (not shown) it is possible to display the symbols SUN, MON, TUE, WED, THU, FRI and SAT. A plan view of the electrode plates 20, 21, 22 when they have been stacked or superimposed one upon another is indicated by reference numeral 30 in Figure 5. In other respects the display device of Figure 5 is similar to the display device of Figure 3.

As will be appreciated, the above described display device enables numerals and characters having a natural appearance to be displayed without providing an electrode plate for each numeral and character to be displayed. The display devices according to the present invention are particularly suitable for use in electronic watches. Moreover they may be used or modified to display both numerals and characters.

WHAT WE CLAIM IS:—

1. A display device comprising two electrode plates on each of which is formed a plurality of individually energisable electrode segments, and a third electrode plate on which is formed a common electrode, the said two electrode plates being separated by an electrically insulating layer, and a liquid crystal material is disposed between one of said two electrode plates and the third electrode plate, the electrode segments overlapping when the display device is viewed in plan.

2. A display device as claimed in claim 1 arranged to display the symbols SUN, MON, TUE, WED, THU, FRI and SAT.

3. A display device substantially as herein described with reference to and as shown in Figures 3 to 5 of the accompanying drawings.

4. An electronic watch including a display device as claimed in any preceding claim.

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