A timepiece using a liquid crystal panel for display of the time has maximized display area while concealing the spacer and the filling hole. Assembly is facilitated by use of a case body having a notch with a sloping wall which guides electrical connectors into position so as to make contact between the electronic circuitry and electrical elements comprising the display portions of the display panel.
LIQUID CRYSTAL TIMEPIECE WITH IMPROVED DISPLAY PANEL

BACKGROUND OF THE INVENTION

In the conventional liquid crystal display panel as used in a timepiece, two plates held apart by a spacer about 10 microns thick define a chamber which is filled with liquid crystal material through an opening in one of the plates, said opening being subsequently closed by means of a stopper such as a metallic pin. The outer plate of the display panel is transparent and has on the interior thereof a conductive coating which is also transparent. The inner plate also has a conductive coating thereon, one of said coatings being divided into segments which can be selectively activated by application of a voltage to display indicia or numerals showing the time. In general, it is convenient that the outer plate should overlap the inner plate and conductive leads are taken from the segments on one plate and the coating on the other plate out of the cell along that portion of the outer plate which overlaps the spacer.

To actuate the display panel, i.e. to make selected segments of the coating active so that selected numerals are displayed, it is necessary that electrical signals be brought to the appropriate segment leads. Such electrical signals are produced by a battery, a time standard high frequency oscillator, a frequency divider and decoder. Connecting means must be provided to supply signals from the decoder which, in general, is in the form of an IC chip to the selected segment leads.

Due to the fact that the number of leads from the electronic circuitry to the display panel may be as large as 40 or even greater, depending on whether such features as the day and the date are to be shown, and also due to the fact that timepieces when in the form of wristwatches, particularly for ladies, are limited in size, it becomes very difficult to establish solder connections between the connecting strips and the segment leads. Consequently, it is highly desirable that effective and reliable electrical connection be made mechanically between the conductive strips and the segment leads. Further, it is essential that the conductive leads be guided into place as the watch is assembled in order to insure proper correspondence between the conductive leads and the segment leads.

For maximum legibility, it is necessary that the display panel occupy as large a portion of the outer surface of the timepiece as is possible. Consequently, an arrangement must be provided wherein the battery and the electronic circuitry lie behind the display panel and the frame holding same to the case body.

SUMMARY OF THE INVENTION

A liquid crystal display panel is held to the base of a timepiece by a frame having an opening such that it narrowly overlaps the spacer separating the plates of said display panel and also overlaps the filling hole by which liquid crystal is introduced into said display panel. One of the plates of said display panel overlaps the spacer and the other plate. Leads from the segments activatable to display digits are brought out of the liquid crystal chamber along the inner face of the overlapping plate. The base on which said panel and said frame are mounted has a notch therein, said notch having an outer wall which slopes inwardly from the rear of the watch toward the front surface of the watch. The electronic circuitry which is powered by a battery has output leads in the form of resilient conductive strips. In bringing the electronic circuitry into place within the case body, the resilient metal strips make contact with the outer wall of the notch and are guided thereby into place so that they will make contact with the appropriate, corresponding segment leads. Where the outer wall of the notch is metallic, insulating means are provided for preventing short circuiting between the leads.

Accordingly, an object of the present invention is to provide an improved display panel for an electronic timepiece wherein the display panel has maximized area for increased legibility of indicia displayed thereon.

Another object of the present invention is an improved electronic timepiece using a liquid crystal chamber for a display panel where the spacer and the filling hole are concealed by a frame.

A further object of the present invention is an improved electronic timepiece using a liquid crystal display panel wherein electrical contact between the electronic circuitry and the display panel is made mechanically and wherein guidance of the leads is provided as the electronic circuitry is inserted into the base so that the proper sequence of contacts between the circuitry elements and the display elements is insured.

Still other objects and advantages of the invention will in part be obvious and will in part be apparent from the specification.

The invention accordingly comprises an article of manufacture possessing the features, properties, and the relation of elements which will be exemplified in the article hereinafter described, and the scope of the invention will be indicated in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a fuller understanding of the invention, reference is had to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a sectional view of a conventional liquid crystal display panel held in a frame;
FIG. 2 is a sectional view of a panel, base and circuitry in accordance with the present invention;
FIG. 2a is a view taken along line 2a—2a of FIG. 2;
FIG. 3 is a panel, base and circuitry in accordance with the present invention represented during the course of assembly;
FIG. 4 is a plan view of a panel, base and circuitry in accordance with the present invention;
FIG. 5 is a plan view of another embodiment of the present invention showing how the frame can be used for the display of characters; and
FIG. 6 is a sectional view of a timepiece incorporating the panel, base and circuitry of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A conventional liquid crystal display panel for a timepiece is shown in FIG. 1 wherein liquid crystal material is held in a space defined by upper panel 1, lower panel 2 and spacer 3. Transparent conductive segments 4 which are coated on the inner surfaces of conductive panels or plates 1 and 2 are schematically representative of a plurality of segments supplied with leads (not shown) traversing the spacer 3 so that electrical con-
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Liquid crystal material is introduced into the display panel through passage 6 which is then sealed with a stopper 7 which may be of a suitable resistant rubber or may be a metallic pin.

Frame 8 holds the display panel to the timepiece case or wristwatch case. As can be seen from FIG. 1, frame 8 extends only a short distance over plate 1, so that spacer 3 and filling hole 6 are visible from the exterior of the timepiece. Since spacer 3 may have rough edges and filling hole 6 with its stopper are not conducive to an attractive appearance, such an arrangement is relatively unappealing to the eye.

FIG. 2 shows an arrangement in accordance with the present invention wherein the disadvantages of the embodiment of FIG. 1 are eliminated. In this embodiment, frame 11 overlaps filling hole 6 and the stopper 7 therein minimally, i.e., by as small an amount as is consistent with hiding same and simultaneously hiding spacer 3 from view. This arrangement of the panel frame and the panel itself allows for maximum display space commensurate with hiding from view the extraneous components 3, 6 and 7.

FIG. 2 also shows in some detail how the frame and the panel mounted in a recess therein are held in a base. Frame 11 is secured to base 13 by means of screws 14. The central portion of base 13 lies between the display panel and encasement 17. Encasement 17 holds within it portions of circuit elements where the totality of said circuit elements includes a battery, a time standard high frequency oscillator and frequency divider and a decoder (not shown). Said circuit elements including encasement 17 are mounted on signal distributor 12.

Base 13 has a notch 16 therein through which pass conductive strips 15 which are of resilient material. Conductive strips 15 are soldered to signal distributor 12 and make electrical contact mechanically with leads 10 which serve to impose a voltage on conductive segments 4 on the interior of the two plates of which the display panel is formed.

Where the base 13 is of conductive material, it is desirable that insulation 15a be introduced to prevent short circuiting of conductive strips 15 due to contact with base 13. One form of insulation by which such short circuit may be avoided is shown in enlarged scale in FIG. 2a where the insulation consists of a perforated strip 15a, preferably of a flexible rubber material or of a plastic. Conductive metal strips 15 pass through perforations in strip 15a and make contact with segment leads 10 which are in the form of conductive coatings on the interior surface of upper plate 9.

The outer wall 21 of notch 16 is inclined inwardly in passing from the rear of the base to the front of the base. The function is shown more clearly in FIG. 3 which shows the panel, base and circuitry in the process of assembly, namely at the step wherein the electronic circuitry is being brought into position. The movement of the panel 24 and the electronic circuitry 17 toward each other is indicated by the arrows 23 and 26. Conductive strips 15 are so mounted on chips 12 that they bear against inclined surfaces 21. Strips 15, being of resilient material are forced inwardly toward the central portion of case 19 as the panel and the circuitry are moved toward each other. As circuitry 17 is seated in recess 19, resilient metal strips 15 make mechanical and thereby electrical contact with segment leads 10 (FIG. 2A). Where base 19 is of electrically conductive material, insulating strips 19a are provided on the upper portion of outer wall 21 of notch 16. As is the case with strip 15a, strips 19a serve to prevent short circuiting between the flexible metal strips 15. The assembly is held together by screws 25 and screw pins 22.

The appearance of a display panel in accordance with the present invention as mounted in a wristwatch and as seen by the wearer is shown in FIG. 4, where, as can be seen, frame 11 overlapps space 3 and filling hole 6 minimally in order to provide maximum area for display of time. A segment lead 10 is also shown as is the end of a conductive strip 15 making contact therewith.

The width of the frame 11, necessary in order to shield from view filling hole and spacer 3 as well as to provide an adequate recess for overlapping upper plate 9, may be used for imprinting characters such as the name of the manufacturer as shown in FIG. 5. Here the peripheral area 28 is used for inscription 27. The display area is indicated by the reference numeral 29.

The manner in which display panel 9, frame 11 and the circuitry of the present invention fit within a watch case 30 is shown in FIG. 6.

It will thus be seen that the objects set forth above, among those made apparent from the preceding description, are efficiently attained and, since certain changes may be made in the above article without departing from the spirit and scope of the invention, it is intended that all matter contained in the above description and shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

It is also to be understood that the following claims are intended to cover all of the generic and specific features of the invention herein described, and all statements of the scope of the invention which, as a matter of language, might be said to fall therebetween.

What is claimed is:

1. An electronic timepiece comprising a liquid crystal display panel for displaying the time, said panel including an upper plate, a lower plate, a spacer between said plates and around the periphery of said lower plate, one of said plates having a passage therethrough proximate to said spacer for introducing liquid crystal into the space defined by said plates and said spacer, and a stopper in said passage; a base; a frame having a recess therein for receiving said display panel, and an opening through which said panel may be viewed, said frame overlapping said spacer and said passage minimally, thereby providing maximum space on said display panel for display of time while hiding from view said spacer and said passage; electronic circuitry for timekeeping and driving said display panel; electrical connecting means connecting the output of said electronic circuitry to said display panel for actuating said display panel and displaying the time; and holding means for holding said circuitry and said frame to said base, wherein said base has a notch therein, the shape of said notch being such as to provide for transit therethrough of said connecting means between said electronic circuitry and said display panel.

2. The electronic timepiece as defined in claim 1 wherein said connecting means consists of resilient electrically conductive metal strips.

3. The electronic timepiece as defined in claim 1 wherein said notch has an outer wall sloping inwardly in passing from the rear of said timepiece toward said panel and said metal strips are attached to said elec-
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5 electronic circuitry so that said strips bear against said sloping wall and are forced inwardly with respect to same as said circuitry is brought into place in said base, said flexible strips being of length such that they made electrical contact mechanically with said display panel as said circuitry is seated in said base.

4. The electronic timepiece as defined in claim 3 wherein the outer wall of said notch in said base is electrically conductive and insulating means are provided between said outer wall and said strips which prevent electrical shorting between said strips.

5. The electronic timepiece as defined in claim 4 wherein said insulating means is an insulating liner affixed to the outer wall of said notch.

6. The electronic timepiece as defined in claim 4 wherein said insulating means consists of insulating material affixed to said strips so positioned as to hold said strips away from said outer wall of said notch.

7. The electronic timepiece as defined in claim 1 wherein said liquid crystal display panel and said electronic circuitry sandwich said base.

8. The electronic timepiece as defined in claim 1 wherein said frame has characters marked on the outer surface thereof.

9. An electronic timepiece comprising a liquid crystal crystal display panel including an upper plate and a lower plate, at least one of said plated having conductive leads on a surface thereof, said leads being accessible suitably for connection to an exterior source of voltage; a base having a notch therein; a frame having a recess therein for receiving said display panel; electronic circuitry for timekeeping and driving said display panel; resilient, electrically-conductive metal strips for connecting said circuitry to said conductive leads and making mechanical contact with said leads, said strips traversing said notch in said base; holding means for holding together said frame, base and circuitry, said notch having an outer wall sloping inwardly in passing from the rear of said timepiece toward said panel and said metal strips being attached to said electronic circuitry so that said strips bear against said sloping wall and are forced inwardly with respect to same as said circuitry is brought into place in said base.

10. The electronic timepiece as defined in claim 9, wherein the outer wall of said notch in said base is electrically conductive and insulating means are provided between said outer wall and said strips which prevent electrical shorting between said strips.

11. The electronic timepiece as defined in claim 10, wherein said insulating means is an insulating liner affixed to the outer wall of said notch.

12. The electronic timepiece as defined in claim 10, wherein said insulating means consists of insulating material affixed to said strips so positioned as to hold said strips away from said outer wall of said notch.

13. The electronic timepiece as defined in claim 9, wherein said liquid crystal display panel and said electronic circuitry sandwich said base.

14. The electronic timepiece as defined in claim 9, wherein said frame has characters marked on the outer surface thereof.

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