SPECIFICATION

A module structure for an electronic watch

At present, an electronic timepiece is generally made up of a liquid crystal display cell, a reflector plate positioned beneath the cell, a circuit board containing timekeeping circuitry, a pair of connectors provided to electrically connect the liquid crystal display cell to the circuit board, and a battery, all contained within a case. Currently, the usual arrangement utilized for assembling such a timepiece includes a base, generally made of plastic, having a recessed portion in the upper surface. The liquid crystal cell is fixed in this recessed portion by means of some type of fastening member or members, and the circuit board is located on the lower part of the base. In such a prior art arrangement, the disadvantage arises that the space required for the fastening members acts to limit the effective area usable for display. In addition, these fastening members result in an increase in the total number of separate components which must be assembled to build a timepiece, which is another disadvantage.

Another disadvantage of such a prior art arrangement lies in the method whereby the timepiece is assembled. First the circuit board is placed upon the lower part of the plastic base. Next, the liquid crystal cell connectors are placed in position upon the circuit board. The liquid crystall cell is then positioned on the cell connectors, and is then fastened into place by means of the fastening members referred to above. Once this is accomplished, then the pressure exerted by the liquid crystal cell serves to retain the liquid crystal cell connectors in place. However, until this is done, the liquid crystal cell connectors, which are generally composed of a conductive rubber material, can accidentally be displaced from their correct positions on the circuit board. The action of placing the liquid crystal cell onto the cell connectors can in fact displace the connectors from their desired positions, so that the assembly of such a timepiece becomes a rather delicate and difficult procedure.

With the present invention, the various disadvantages of the prior art methods of manufacturing and assembling electronic timepieces are effectively eliminated. Means can be provided whereby the circuit board and the liquid crystal cell connectors are restrained against undesired movement during the assembly process. In addition, the present invention teaches means whereby a liquid crystal cell, liquid crystal cell connectors and a circuit board can be assembled as a components of a single module, in which the various components are securely retained in place before the module is inserted into the timepiece case, and whereby the action of inserting this module into the timepiece case causes the module and its components to be securely retained within the case, without the need for additional attachment members.

According to the present invention, there is provided a module structure for an electronic watch having a watch case, comprising: a liquid crystal display cell; a circuit board having an IC chip mounted thereon; a plurality of connector members sandwiched between said display cell and said circuit board to provide an electrical conductance therebetween; a module supporting frame including a radial wall, a first set of circuit board attachment hooks formed in close proximity to an outer periphery of said radial wall, and a second set of display cell securing hooks formed in close proximity to the outer periphery of said radial wall; said first and second sets of hooks being positioned such that said first set of hooks retain said circuit board in a fixed place relative to said radial wall and said second set of hooks retain said display cell in a fixed place relative to said circuit board to maintain said connector members in a sandwiched state between said display cell and said circuit board.

Embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1 is a cross-sectional view in elevation of a timepiece module according to a first preferred embodiment of the present invention;

Figure 2 is a cross-sectional view in elevation of the timepiece module of Figure 1 assembled onto an electronic timepiece;

Figure 3 is a plan view, viewed from above, of a module supporting frame of the embodiment of Figures 1 and 2;

Figure 4A to *4D* are partial cross-sectional views illustrating the configuration of attachment hooks provided on the periphery of the module supporting frame of the embodiment of Figures 1 and 2;

Figure 5 is a plan view, viewed from below, of the module supporting frame of Figure 3;

Figure 6 is a cross-sectional view in elevation of the module supporting frame of Figures 3 and 5;

Figure 7 is a partial cross-sectional view in elevation of a second embodiment of an electronic timepiece according to the present invention;

Figure 8 is a plan view of a module supporting frame of the embodiment of Figure 7; and

Figure 9 is a partial cross-sectional view to illustrate the relationship between a guide pin and a hook member on a module supportion frame of the embodiment of Figure 7.

A first preferred embodiment of the present invention will now be described, referring first to Figure 1. Reference numeral 10 denotes a module supporting frame, which is made of a resilient material such as plastic. Module supporting frame 10 includes a radial wall or seating portion, denoted by numeral 12, and six partial side wall portions denoted by numeral 14, which are indicated in the plan view of the module supporting frame 10 shown in Figure 3 (viewed from above). Four of these side wall portions 14 project upward at each of the corners of module supportng frame 10, while two of the side wall portions project upward on opposite sides of the module supporting frame. On opposite sides of the seating portion 12 are formed two liquid crystal cell securing hooks 16, and similarly, on each of these opposite sides of the seating portion are formed two circuit board attachment hooks 18. A module attachment hook 20 is formed at each of four side wall portions 14, at the positions indicated in the

plan view of Figure 3. A slit 22 is provided below each of these module attachment hooks 20 to provide sufficient resilience. Each module attachment hook 20 is provided with an outwardly projecting portion having a guiding surface 24 thereon.

As can be seen from Figure 2, which is a cross-sectional view showing a timepiece assembled according to the first embodiment, a small space is provided between the outwardly projecting portion of each of the module attachment hooks 20 and the inner wall of watch case 11. Further, a small space is provided between the protruding portion 16a of the cell securing hooks 16 and the inner wall of the case bezel 44. These spaces are provided to allow for any dimensional change of the module supporting frame, due to changes with aging or due to impact force being applied to the timepiece. In the case of a module supporting frame made of a resin material, such dimensional changes can occur due to "creep".

As shown in the plan view of Figure 3 and Figure 5, access apertures are provided in module supporting frame 10, to permit access to a battery (through aperture 26) and to an integrated circuit (IC) chip 30 (through aperture 28).

The assembly of a timepiece in accordance with the first embodiment of the present invention will now be described, beginning with the assembly of the module shown in Figure 1. First, the circuit board 32 is pressed downward into the module supporting frame 10, thereby pushing apart the circuit board attachment hooks 18. When circuit board has been depressed sufficietly to be firmly seated on seating portion 12, circuit board attachment hooks 18 snap back into position, thereby retaining circuit board 32 securely in position. In order to assist in locating circuit board 32 in the correct position during this procedure, guide pins 27 and 31 are provided on module supporting frame 10, protruding upward from seating portion. These engage in corresponding apertures provided in circuit board 32.

Next, liquid crystal cell connectors or connector members 34, consisting of strips of conductive rubber material, are placed in position on circuit board 32. A reflector plate 36 is then placed on the circuit board 32. Numeral 38 denotes an upper glass plate, which is attached beforehand to liquid crystal display 40, and which is provided with conductors connected to the electrodes of liquid crystal display cell 40. Glass plate 38, with the liquid crystal display cell 40, is then placed upon the liquid crystal cell connectors 34, by being pushed downward into the module supporting frame 10. When glass plate 38 has been pushed inward sufficently far, liquid crystal cell securing hooks 16, which have been pushed apart, snap back to their previous positions, thereby securing the glass plate 38, liquid crystal display cell 40, liquid crystal cell connectors 34, circuit board 32 and module supporting frame 10 into a single self-supporting module. As shown, IC chip 30 now protrudes downward through access hole 28. In the succeeding stages of timepiece assembly, this module may be handled as an individual unit.

The module thus formed is now inserted into a watch case 11, from the top of the watch case. A module retaining member 42 in the shape of a ring is provided attached to the inner periphery of watch case and protruding radially inward. As the module is pushed into watch case 11, the inclined guiding portion 24 of each of the module attachment hooks 20 is first pushed radially inward by ring member 42, then springs outward, to secure the module within watch case 11. At this point, the under surface of module supporting frame 10 is seated upon an upper surface of watch case 11, as shown in Figure 2. In addition, each of the six side wall portions 14 of the module supporting frame 10 abuts against the inner wall of watch case 11, so that the module is now correctly positioned with wall portions 14 aligned parallel to the inner wall of watch case 11, so that the module is correctly positioned. The case bezel 44, to which a watch crystal 138 has been previously attached, is then press-fitted into watch case 11. The battery 46 is then inserted, and a battery cover 48 is screwed into a recess provided in watch case 11. Battery 46 is held in place by a battery retaining spring 50. When the battery cover 48 is screwed down, with a battery 46 installed, a battery connection spring 53 is compressed, thereby connecting a conductor provided on circuit board 32 to an electrode of battery 46. Assembly of the timepiece is now complete.

For greater ease of understanding of the configuration of the module supporting frame of the first embodiment, partial cross-sectional views of a liquid crystal cell securing hook 16, a circuit board attachment hook 18, a partial side wall portion 14, and a module attachment hook 20, are shown in Figure 4A, 4B, 4C and 4D. The configuration of the module supporting frame 10 is further illustrated by the cross-sectional view of Figure 6, which is taken along line E-E of Figure 5. The latter figure is a plan view of the module supporting frame 10 as viewed from below.

From the above description, it will be apparent that assembly of an electronic timepiece in accordance with the present invention can be more rapidly and easily performed than is the case with conventional methods of assembly. This is due to the fact that, at each stage of the assembly process, previously assembled components are either securely retained or are restrained against movement out of predetermined positions. It will also be apparent that the effective display area available for the liquid crystal cell is greater than in the case of a prior art electronic timepiece, since the inner periphery of the head portion of each of the liquid crystal cell securing hooks can be located very close to the outer periphery of the watch crystal. This is made possible by the fact that separate fixing member such as screws are not utilized to secure the cell 16 in position, as is done in the case of a time-piece of conventional design.

Referring now to Figure 7, a partial cross-sectional view in elevation is given therein of the construction of an electronic timepiece in accordance with a second embodiment of the present invention. Reference numeral 11 denotes a watch case, the timepiece comprising a wristwatch in this embodiment. Numeral 110 denotes a module supporting frame. This performs an identical function to the module

supporting frame 10 of the first embodiment described hereinabove, although the actual physical configuration is slightly different. This module supporting frame is shown in plan view from above in Figure 8. Module supporting frame 110 serves to support and retain a circuit board 32, resting upon an upper face of the module supporting frame 110, a reflector plate 36 resting on circuit board 32, a liquid crystal cell 40 positioned above reflector plate 36, and two liquid crystal cell connectors 34, positioned between the liquid crystal cell 40 and circuit board 32. One of these liquid crystal cell connectors is shown in Figure 7, denoted by numeral 34. These liquid crystal cell connectors may be made of a resilient material such as a type of rubber, having conducting portions provided therein, for providing electrical connection between the liquid crystal cell 40 and the circuit board 32. These electrical connections are established between electrode portions formed on circuit board 32 and corresponding electrodes provided on the underside of liquid crystal cell 40, and it is therefore essential that the liquid crystal cell connectors be kept in an accurate predetermined position relationship between the circuit board 32 and the liquid crystal display cell 40 during assembly of the timepiece. To this end, sets or rows of guide pins 52 are provided upon module supporting frame 110, protruding upward from the face upon which circuit board 32 rests. These guide pins 52 are of sufficient length to protrude through corresponding holes provided in circuit board 32 and appear in relation to circuit board 32 as illustrated in the partial cross-sectional diagram of Figure 9. A set of circuit board attachment hooks, each having the shape in cross-section shown in Figure 7, are provided near the periphery of module supporting frame 110, positioned with respect to the guide pins 52 as shown in Figure 8. Each of these circuit board attachment hooks 18 is provided with a guide plane portion 18a, angled as shown in the drawings. The first stage in assembly of the timepiece is to align the guide pins 52 below the holes 54 in circuit board 32, and then to push circuit board 32 downward onto module supporting frame 110. As a result of the shape of circuit board attachment hooks 18, and the resiliency of these hooks, circuit board 32 becomes securely retained below the inwardly protruding head portions of the circuit board attachment hooks 18, on module supporting frame 110. The liquid crystal cell connectors are then placed upon circuit board 32, between the head portions of the circuit board attachment hooks and the protruding portions of guide pins 52, as indicated in Figure 9. Partial side wall portions are provided upon module supporting frame 110, as indicated in Figure 8 and denoted by numeral 56. These side wall portions 56 each have a height sufficent to protrude above the upper surface of circuit board 32, and serve to restrain liquid crystal cell connectors 34 against longitudinal movement along the line of alignment of guide pins 52. Thus, once each of the liquid crystal cell connectors 34 has been placed in position upon circuit board 32, the connector is restrained against movement from that position during the next steps of the assembly procedure.

Next, a reflector plate 36 is placed on circuit board 32. As indicated in Figure 7, reflector plate 36 is also aligned in a correct position and restrained against movement from that position by means of guide pins 52 protruding above circuit board 32. A liquid crystal cell 40 is then added to the assembly. In order to facilitate this, a set of liquid crystal cell securing hooks, 116 are provided near the periphery of module supporting frame 110. Liquid crystal cell securing hooks 116 are each provided with a guide plane portion upon the head portion thereof, as in the case of the circuit board attachment hooks 18. Thus, when liquid crystal cell 40 is pushed downward toward module supporting frame 110, after having first being positioned centrally with respect to the frame, cell 40 becomes securely attached between liquid crystal cell connectors 34 and the head portions of the liquid crystal cell securing hooks, as illustrated in Figure 7. A self-supporting module has now been assembled, comprising module supporting frame 110, circuit board 32, reflector plate 36, liquid crystal cell connectors 34, and liquid crystal cell 40, with all of the components of this module being securely held in the correct positions.

In order to secure this module within watch case 11, a set of eight outwardly protruding portions 58 are provided around the periphery of module supporting frame 110. Each of these protruding portions has a guide plane portion formed on the lower part thereof. A corresponding stepped portion or a module retaining member is provided around the inner periphery of watch case 11, as denoted by reference numeral 60. The dimensions of watch case 11 and module supporting frame 110 are arranged such that, when module supporting frame 110 is arranged centrally with respect to watch case 11, and is then pushed downward into watch case 11, each of outwardly protruding portions 58 becomes first deformed inward, then snaps outward to be retained below the stepped portion to watch case 11. The module supporting frame 110, with its attached components, is now secured within watch case 11.

From the above description of the embodiments of the present invention, it will be apparent that the present invention considerably facilitates the assembly of an electronic timepiece having a liquid crystal display cell, and also increases the effective display area available from the liquid crystal cell. This is accomplished by the use of resilient hook members provided around the periphery of a module supporting frame, which serve to retain various components in a unitary structure to form a self-supporting module, and which further serve to secure this module within the timepiece outer case. No separate fixing members, other than the module supporting frame with its hooks, are required. Thus, the total number of individual components required to assemble a timepiece are substantially reduced. In addition, since such operations as screwing for the purpose of securing the liquid crystal cell etc. are eliminated, the assembly process can be considerably hastened and simplified. In addition, use of guide pins provided on the module supporting frame serve to correctly position such components as a circuit board during the assembly process, and

to restrain such components against movement during the succeeding steps of assembly.

Various changes and modifications to the above construction may be made without departing from the scope of the present invention and it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative, and not in a limiting sense.

CLAIMS

1. A module structure for an electronic watch having a watch case, comprising:
a liquid crystal display cell;
a circuit board having an IC chip mounted thereon;
a plurality of connector members sandwiched between said display cell and said circuit board to provide an electrical conductance therebetween;
a module supporting frame including a radial wall, a first set of circuit board attachment hooks formed in close proximity to an outer periphery of said radial wall, and a second set of display cell securing hooks formed in close proximity to the outer periphery of said radial wall;
said first and second sets of hooks being positioned such that said first set of hooks retain said circuit board in a fixed place relative to said radial wall and said second set of hooks retain said display cell in a fixed place relative to said circuit board to maintain said connector members in a sandwiched state between said display cell and said circuit board.

2. A module structure according to claim 1, in which said module supporting frame further includes a plurality of module attachment hooks formed at the outer periphery of said module supporting frame, said module attachment hooks being engageable with a module retaining member of said watch case whereby said module supporting frame may be securely supported in said watch case.

3. A module structure according to claim 1 or 2, in which said radial wall has first and second access apertures for accommodating said IC chip and a battery connection spring, respectively.

4. A module structure according to claim 1 or 2, in which said module supporting frame further comprises first and second row to guide pins protruding from said radial wall to retain said plurality of connector members in respective fixed positions relative to the circuit board.

5. An electronic watch structure comprising:
a watch case;
a watch glass;
a liquid crystal display cell;
a circuit board having an IC chip mounted thereon;
a plurality of connector members sandwiched between said display cell and said circuit board to provide an electrical conductance therebetween;
a module supporting frame including a radial wall, a first set of circuit board attachment hooks formed in close proximity to an outer periphery of said radial wall, and a second set of display cell securing hooks formed in close proximity to the outer periphery of said radial wall;
said first and second sets of hooks being positioned such that said first set of hooks retain said circuit board in a fixed place relative to said radial wall and said second set of hooks retain said display cell in a fixed place relative to said circuit board to maintain said connector members in a sandwiched state between said display cell and said circuit board.

6. An electronic watch structure according to claim 5, in which said watch case has a module retaining member, and said module supporting frame further including a plurality of module attachment hooks formed at the outer periphery of said module supporting frame, said module attachment hooks being engaged with said module retaining member of said watch case whereby said module supporting frame is securely supported in said watch case.

7. An electronic watch structure according to claim 5 or 6, in which said radial wall has first and second access apertures for accommodating said IC chip and a battery connection spring, respectively.

8. An electronic watch structure according to claim 5 or 6, in which said module supporting frame further comprises first and second rows of guide pins protruding from said radial wall to retain said plurality of connector members, in respective fixed positions relative to the circuit board.

9. An electronic watch substantially as hereinbefore described with reference to the accompanying drawings.

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to restrain such components against movement during the succeeding steps of assembly.

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CLAIMS

1. A module structure for an electronic watch having a watch case, comprising:

a liquid crystal display cell;

a circuit board having an IC chip mounted thereon;

a plurality of connector members sandwiched between said display cell and said circuit board to provide an electrical conductance therebetween;

a module supporting frame including a radial wall, a first set of circuit board attachment hooks formed in close proximity to an outer periphery of said radial wall, and a second set of display cell securing hooks formed in close proximity to the outer periphery of said radial wall;

said first and second sets of hooks being positioned such that said first set of hooks retain said circuit board in a fixed place relative to said radial wall and said second set of hooks retain said display cell in a fixed place relative to said circuit board to maintain said connector members in a sandwiched state between said display cell and said circuit board.

2. A module structure according to claim 1, in which said module supporting frame further includes a plurality of module attachment hooks formed at the outer periphery of said module supporting frame, said module attachment hooks being engageable with a module retaining member of said watch case whereby said module supporting frame may be securely supported in said watch case.

3. A module structure according to claim 1 or 2, in which said radial wall has first and second access apertures for accommodating said IC chip and a battery connection spring, respectively.

4. A module structure according to claim 1 or 2, in which said module supporting frame further comprises first and second row to guide pins protruding from said radial wall to retain said plurality of connector members in respective fixed positions relative to the circuit board.

5. An electronic watch structure comprising:

a watch case;

a watch glass;

a liquid crystal display cell;

a circuit board having an IC chip mounted thereon;

a plurality of connector members sandwiched between said display cell and said circuit board to provide an electrical conductance therebetween;

a module supporting frame including a radial wall, a first set of circuit board attachment hooks formed in close proximity to an outer periphery of said radial wall, and a second set of display cell securing hooks formed in close proximity to the outer periphery of said radial wall;

said first and second sets of hooks being positioned such that said first set of hooks retain said circuit board in a fixed place relative to said radial wall and said second set of hooks retain said display cell in a fixed place relative to said circuit board to maintain said connector members in a sandwiched state between said display cell and said circuit board.

6. An electronic watch structure according to claim 5, in which said watch case has a module retaining member, and said module supporting frame further including a plurality of module attachment hooks formed at the outer periphery of said module supporting frame, said module attachment hooks being engaged with said module retaining member of said watch case whereby said module supporting frame is securely supported in said watch case.

7. An electronic watch structure according to claim 5 or 6, in which said radial wall has first and second access apertures for accommodating said IC chip and a battery connection spring, respectively.

8. An electronic watch structure according to claim 5 or 6, in which said module supporting frame further comprises first and second rows of guide pins protruding from said radial wall to retain said plurality of connector members, in respective fixed positions relative to the circuit board.

9. An electronic watch substantially as hereinbefore described with reference to the accompanying drawings.

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