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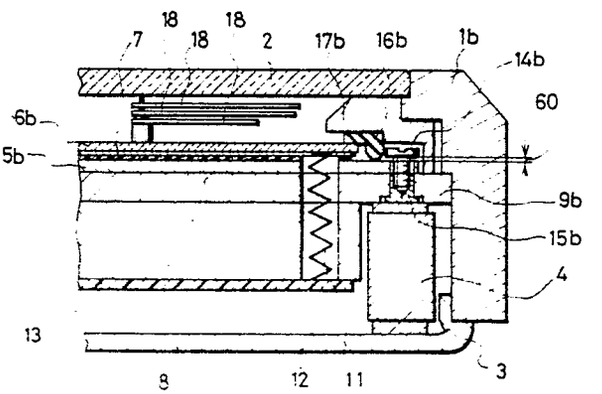
(54) Electronic timepiece with a solar cell.

(57) An electronic timepiece comprising a translucent member (6, 6b), which carries a solar cell (7); a support plate (5, 5b) which supports the translucent member (6, 6b); a base plate (9, 9b) which supports the support plate (5, 5b); and a case (1, 1b) within which the translucent member (6, 6b), solar cell (7), support plate (5, 5b) and base plate (9, 9b) are disposed characterised in that the base plate (9, 9b) engages the case (1, 1b); the support plate (5, 5b) is disposed in contact with the base plate (9, 9b); and resilient means (16, 16b, 16c, 16d) are interposed between the support plate (5, 5b) and the case (1. 1b), or means (17b, 17c, 17d) connected to the latter.

FIG. 2



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"ELECTRONIC TIMEPIECE WITH A SOLAR CELL"

This invention concerns an electronic timepiece having a solar cell.

An electronic timepiece is known comprising a translucent member which carries a solar cell; a support plate which supports the translucent member; a base plate which supports the support plate; and a case within which the translucent member, solar cell, support plate and base plate are disposed.

In the known timepiece, however, it has been necessary to provide a substantial clearance between the base plate and the support plate to reduce the risk of the translucent member being cracked when the timepiece is subjected to a shock.

According, therefore, to the present invention, there is provided an electronic timepiece comprising a translucent member which carries a solar cell; a support plate which supports the translucent member; a base plate which supports the support plate; and a case within which the translucent member, solar cell, support plate and base plate are disposed characterised in that the base plate engages the case; the support plate is disposed in contact with the base plate; and resilient means are interposed between the support plate and the case or means connected to the latter.

Preferably, the translucent member is a translucent dial which carries the solar cell on its rear face.

The support plate may have a portion which extends outwardly of the translucent member, the resilient means engaging the said outwardly extending portion.

The base plate preferably engages a shoulder in the case.

The support plate may be secured to the base plate by means of a plurality of guide pins.

Each guide pin may comprise a screw having a head which is disposed adjacent to the support plate to prevent outward movement of the latter.

The resilient means may have a portion which engages the translucent member to prevent the latter from being separated from the support plate.

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

Figure 1 and Figure 2 are broken away sectional views of first and second embodiments respectively of an electronic wrist watch according to the present invention,

Figure 3 and Figure 4 are sectional fragmentary views showing components which may form part of the said embodiments of the present invention, and

Figures 5 and 6 are broken away sectional views showing examples of prior art constructions.

Terms such as "upper" and "lower", as used in the description below, are to be understood to refer to directions as seen in the accompanying drawings.

Embodiments of the invention will now be described with reference to Figures 1-4 of the accompanying drawings.

In Figure 1 there is shown a base plate 9 which is disposed within and in direct engagement with a shoulder of a case 1 of a wrist watch. A solar cell 7 is formed on the rear face of a glass or other translucent dial 6 over whose front face move hands 18 which are visible through a cover glass 2 secured to the case 1. At least one contact spring 11 extends between the solar cell 7 and a circuit board 12 secured to a movement 13. A stiffened support plate 5 is secured to and supports the glass dial 6 and the solar cell 7 formed thereon by way of a double-sided adhesive tape 8. The stiffened support plate 5, to which the glass dial 6 is secured, is disposed in direct contact with the base plate 9. A rubber packing 16 which serves as a resilient means, is disposed on an outer peripheral surface of the stiffened support plate 5 where the latter extends outwardly of the glass dial 6, and the rubber packing 16 is held between the case 1 and the stiffened support plate 5. However, other appropriate resilient materials may be selected for the packing 16 instead of rubber. Frame members 4 (only one shown) are disposed in contact with an outer peripheral lower surface of the base plate 9, and with an upper or internal surface of a back case 3 which is engaged with the case 1, thereby fixing the whole structure together.

When an impulsive force due to a shock is applied from above the cover glass 2, the base plate 9 is urged in the direction of the glass dial 6 by virtue of the weight of the movement 13. However. since the case 1 and the base plate 9 are engaged with each other. the impulsive force of the movement 13 can be checked almost perfectly by the base plate 9. Moreover, even if the base plate 9 is bent by the impulsive force of the movement 13 and thus the stiffened support plate 5 is subjected more or less to an impulsive force, nevertheless the latter force will be absorbed by the rubber packing 16.

Next, another embodiment will be described with reference to Figure 2. The construction of Figure 2 is, however, generally similar to that of Figure 1 and consequently the construction of Figure 2 will not be described in detail, the same reference numerals (or similar reference numerals

with the suffix "b")indicating similar parts. In Figure 2, however, in contrast to the construction of Figure 1, a plurality of guide pins 15b (only one shown) pass through a base plate 9b to act as a guide of the required position of a stiffened support plate 5b. A male screw 14b,having a head or collar, is tightened into a tapped hole in the respective guide pin 15b to prevent the stiffened support plate 5b from flying out. Consequently, if an impulsive force is applied to the wrist watch from above the cover glass 2, the base plate 9b is urged in the direction of a glass dial 6b by virtue of the weight of the movement 13. However, since a case 1b of the watch and the base plate 9b are engaged with each other, the impulsive force caused by the weight of the movement 13 can be checked almost perfectly by the base plate 9b. If, however, the base plate 9b were to be bent by the impulsive force of the movement 13 so as to impart an impulsive force more or less to the stiffened support plate 5b, such an impulsive force would be absorbed by a rubber packing 16 b. Then, the glass face 6b with the solar battery 7 formed thereon is joined to the stiffened plate 5b with the double-sided adhesive tape 8.

The glass dial 6b with the solar battery 7 formed thereon and the stiffened support plate 5b are subjected all the time to a force which tends to separate them by the contact spring or springs 11. Therefore the rubber packing 16b is provided with a flange or collar as illustrated which engages an outer peripheral surface of the glass dial 6b, thereby preventing the parts 5b, 6b from being separated from each other. In the Figure 2 construction, moreover, the rubber packing 16 b instead of engaging the case 1b directly, engages a packing ring 17b which itself engages both the case 1 and the cover glass 2.

Each of the guide pins 15 b which pass through the base plate 9b serves as a guide in the plane of the stiffened support plate 5b. A clearance 60 is maintained between the collar or head part of the male screw 14b and the stiffened support plate 5b. If the hands 18 are mounted in position before the rubber packing 16b is installed at the time of the assembly of the watch, the clearance 60 will be effective in preventing the glass dial 6b from flying out by reason of the force exerted by the contact spring 11.

Figure 3 illustrates a modification of the construction of Figure 2 wherein a rubber packing 16c which is T-shaped in cross-section is mounted in an inner peripheral groove of a packing ring 17c, thereby improving the stability of the rubber packing.

Figure 4 illustrates a further modification of the construction of Figure 2 wherein a rubber packing 16d which is T-shaped crosswise in cross section is mounted in a groove of a packing ring 17d to improve the stability of the rubber packing and also to change the longitudinal length of the rubber packing 16d, thereby compensating for shrinkage of the rubber packing 16d.

In order to protect the glass dial 6 which is weak with respect to impulsive force, it has often been separated from other parts in the prior art, even though such arrangement has the disadvantage of increasing the thickness of the wrist watch as a whole. In the constructions shown in Figures 1 and 2, any contact between the glass dial 6 and other members will not prevent the glass dial 6 from being protected from impulsive force, thus removing the disadvantage of the prior art mentioned above. Further, the glass dial 6 can be located in the required plane by means of the guide pins 15b, and thus it is not necessary to make the glass dial 6 itself rectangular in shape. Consequently, the glass dial 6 may have a circular shape so that its production costs can be substantially reduced. Moreover, since the glass dial 6 need not be rectangular, there is a greater degree of freedom for design.

In the prior art, a U-shaped crosswise frame, as indicated by the reference character 10e in Figure 5, must be provided to prevent the glass dial from flying out during assembly due to the lifting force of the contact spring. However, in the construction shown in Figure 2, the glass dial 6b can be securely retained by a simple member such as the male screw 14b, with the result that production costs are reduced and a separate assembly operation is not necessary for the glass dial 6b and frame member 4. Moreover, since the hands 18 can be assembled according to a part stacking system, an automatic line assembly of the movement 13 can also be achieved. Further, varied shapes and materials may be used for the components shown in Figure 3 and Figure 4 which provide resilient means for absorbing impulsive force. Therefore, stability of the packing during and after assembly can be increased, and the shock resistance can also be increased with respect to a vibration mode of impulsive force.

In Figures 5 and 6 there are shown examples of the prior art to illustrate the advantages of the present invention.

In the construction shown in Figure 5, a glass dial 6 e with a solar cell 7 formed thereon is secured to a stiffened support plate 5e by means of a double-sided adhesive tape 8. The stiffened support plate 5e is supported by a frame 10e , the frame 10e being disposed on an upper surface of a base plate 9e so as to enable pins formed on the

frame 10e to engage in guide holes of the base plate 9e . Frame members 4 (only one shown) are disposed in contact with the outer peripheral lower surface of the base plate 9e, the frame 10e and the frame members 4 being held between a case 1e and a back case 3, thereby fixing the whole structure together.

In the construction shown in Figure 6, a glass dial 6f with a solar cell 7 formed thereon and a stiffened support plate 5f with legs 20 formed therefor are incorporated in a frame 10f which is U-shaped crosswise in section. The legs (only one shown) are engaged in guide holes in a movement 13 and in guide holes in a base plate 9 f. Then, the frame members 4 are disposed so as to contact an outer peripheral lower surface of the base plate 9f, and the frame 10f and the frame members 4 are held between a case 1 f and a back case 3, thereby fixing the whole structure together.

In the construction described with reference to Figure 5, unless a sufficiently wide clearance 30 between the base plate 9e and the stiffened support plate 5e is provided, the dial 6e may be accidentally cracked if an impulsive force is applied thereto through the stiffened support plate 5e when the base plate 9e is bent toward the stiffened support plate 5e as the result of an impulsive force being applied to the wrist watch.

Moreover, in the construction of Figure 6, in addition to a limited clearance 40 between the base plate 9f and the stiffened support plate 5f, the arrangement is such that another clearance 50 may arise from the glass dial 6f with the solar cell 7 formed thereon being lifted by a contact spring or springs 11. An impulsive force due to bending of the base plate 9f is unlikely to be imparted to the glass dial 6f if the clearance 50 exists, but the glass dial 6f must be rectangular in outline for circumferential locating, and thus the frame 10f must also be rectangular. Working the glass dial 6f into a rectangular shape is, however, more expensive than giving it a circular shape and imposes limitations in the design.

In the constructions shown in Figures 1 and 2, however, there is no clearance between the stiffened support plate 5, 5b and the base plate 9, 9b. Consequently, if the base plate 9, 9b is bent by an external impulsive force and thus an impulsive force from the base plate 9, 9b is applied to the stiffened support plate 5, 5b, the impulsive force is absorbed by the rubber packing 16, 16b disposed in contact with the outer peripheral upper surface of the stiffened support plate 5, 5b, thus preventing the glass dial 6, 6b from being cracked.

Moreover, in the Figure 2 construction, guide pins 15b pass through the base plate 9b and the stiffened support plate 5b is located on the base plate 9b with the guide pins 15b acting as a guide. Therefore the glass dial 6b joined to the stiffened support plate 5b is adjusted for circumferential position, and thus the glass dial may be made in a circular shape.

The constructions shown in Figures 1 and 2 are effective in preventing the base plate 9, 9b from flying out toward the glass dial 6, 6b because the base plate, 9, 9b is positively engaged in the shoulder of the case 1, 1b even if an impulsive force is applied to the wrist watch. If any such impulsive force is applied to the stiffened support plate 5, 5b it is, as indicated above, absorbed by the rubber packing 16, 16b, thus preventing the glass dial 6, 6b from being cracked.

Claims

1. An electronic timepiece comprising a translucent member (6, 6b) which carries a solar cell (7); a support plate (5, 5b) which supports the translucent member (6, 6b); a base plate (9, 9b) which supports the support plate (5, 5b); and a case (1, 1b) within which the translucent member (6, 6b), solar cell (7), support plate (5, 5b) and base plate (9, 9b) are disposed characterised in that the base plate (9, 9b) engages the case (1, 1b); the support plate (5, 5 b) is disposed in contact with the base plate (9, 9b); and resilient means (16, 16b, 16c, 16 d) are interposed between the support plate (5, 5b) and the case (1, 1b) or means (17b, 17c , 17d) connected to the latter.

2. An electronic timepiece as claimed in claim 1 characterised in that the translucent member (6, 6b) is a translucent dial which carries the solar cell (7) on its rear face.

3. An electronic timepiece as claimed in claim 1 or 2 characterised in that the support plate (5, 5b) has a portion which extends outwardly of the translucent member (6, 6b), the resilient means (16, 16b, 16c , 16d) engaging the said outwardly extending portion.

4. An electronic timepiece as claimed in any preceding claim characterised in that the base plate (9, 9b) engages in a shoulder in the case (1, 1b).

5. An electronic timepiece as claimed in any preceding claim characterised in that the support plate (5b) is secured to the base plate (9b) by means of a plurality of guide pins (15b).

6. An electronic timepiece as claimed in claim 5 characterised in that each guide pin (15b) comprises a screw (14b) having a head which is disposed adjacent to the support plate (5b) to prevent outward movement of the latter.

7. An electronic timepiece as claimed in any preceding claim characterised in that the resilient means (16b, 16c, 16d) has a portion which en-

gages the translucent member (6b) to prevent the latter from being separated from the support plate (5b).

8. An electronic timepiece having a solar cell (7) formed on a glass face (6), characterized in that a stiffened plate (5) is joined to a base plate (9) engaging with a case (1) and said glass face (6) on which the solar cell (7) is formed, said stiffened plate (5) to which the glass face (6) is joined is disposed on said base plate (9), an elastic body (16) is disposed on an outer peripheral upper surface of said stiffened plate (5), and said elastic body (16) is sandwiched between said case (1) and said stiffened plate (5).

FIG. 1

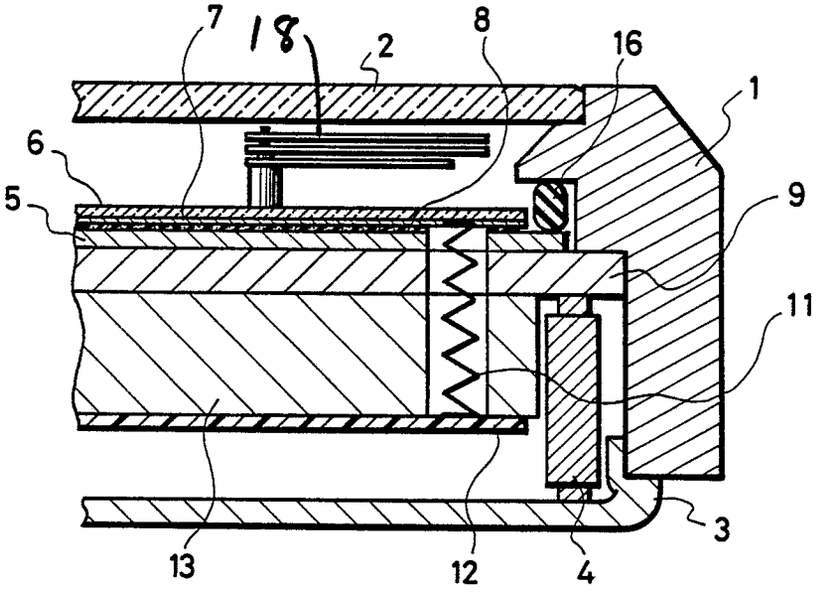
7
18
2
8
16
1
6
5
9
11
3
13
12
4

FIG. 2

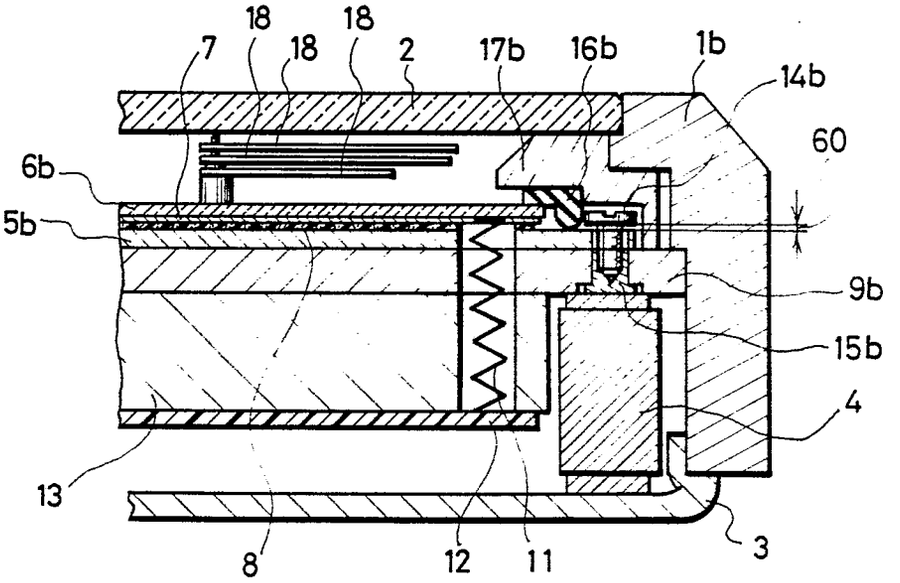
18
18
18
7
2
17b
16b
1b
14b
60
6b
5b
9b
15b
4
13
8
12
11
3

FIG.3

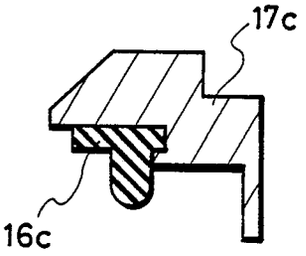

FIG.4

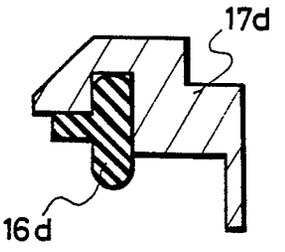

FIG.5 PRIOR ART

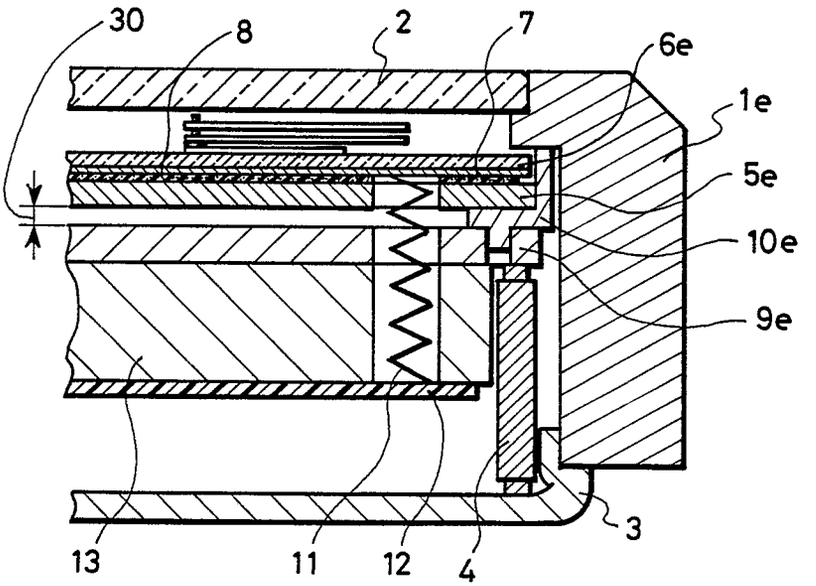

FIG.6 PRIOR ART