"VIBRATOR ASSEMBLY"

This invention relates to a vibrator assembly device and, although the invention is not so restricted, it relates more particularly to a vibrator assembly comprising a piezo-electric vibrator of an alarm buzzer of a timepiece or the like.

A vibrator assembly comprising a piezo-electric vibrator of a timepiece buzzer is known in which one end of a coil spring is positioned in contact with a predetermined circuit pattern on a circuit board, while the other end of the coil spring is positioned in contact with the outer periphery of a piezo-electric element of the piezo-electric vibrator. The coil spring has opposite annular end surfaces which are flat.

As is well known, in order to permit the unimpeded vibration of the vibrator in a buzzer or in a speaker which utilizes the piezo-electric vibrator, a connecting coil spring is preferably positioned in contact with the outer periphery of the piezo-electric element of the vibrator.

However, if it is intended that a coil spring with the structure described above is positioned in contact with the outer periphery of the piezo-electric element, a part of the annular coil spring, whose two ends are flat, is inevitably disposed adjacent to a central portion of the

vibrator. As a result of this, an adequate sound volume cannot be obtained. This phenomenon is especially noticeable in the case of a buzzer for a watch provided with an alarm mechanism having a small diameter piezo-electric vibrator.

According to the present invention, there is therefore provided a vibrator assembly comprising a piezo-electric vibrator; a circuit board; and an electrically conductive coil spring having an annular end portion which is in electrical and mechanical contact with the circuit board, the coil spring having an axially extending end portion which is substantially in point contact with the piezo-electric vibrator and which is connected to a central portion of the coil spring by a substantially radially extending portion.

As will be appreciated, when a vibrator assembly according to the present invention is used in a timepiece in which the piezo-electric vibrator is that of a buzzer, the axially extending end portion of the coil spring can be positioned in contact with a portion of the piezo-electric vibrator in the vicinity of the outer periphery thereof so that an adequate sound volume can be obtained.

The coil spring may be mounted on a support rod which extends axially through the coil spring.

The support rod may be provided with an axially extending groove in which the said axially extending end portion and the said radially extending portion are disposed.

The support rod is preferably provided with guide means to guide the radially extending portion into position when the coil spring is mounted on the support rod. The guide means may comprise guide surfaces which slope with respect to each other. This enables the coil spring to be easily and quickly installed.

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

Figure 1 is a cross-sectional view of a first embodiment of a vibrator assembly according to the present invention,

Figure 2 is a plan view of a coil spring forming part of the structure shown in Figure 1;

Figure 3 is a front view of the coil spring;

Figure 4 is an enlarged cross-sectional view of a portion of the structure shown in Figure 1;

Figure 5 is a plan view of the portion of the structure shown in Figure 4;

Figure 6 is a cross-sectional view of a positioning rod forming part of the structure shown in Figure 1; and

Figure 7 is a cross-sectional view illustrating a second embodiment of a vibrator assembly according to the present invention.

In Figures 1-6 there is shown a first embodiment of a vibrator assembly according to the present invention.

As shown in Figure 1, a back cover 2 is secured to the back of the body 1 of a wrist watch. A sound emitting hole 2a is bored in the back cover 2. In order to provide a good sound effect, it is preferable to arrange that the sound emitting hole 2a is at a position close to a band connecting portion 1a of the body 1 which is connected to a watch band (not shown) so that the hand of the person wearing the watch does not block the sound emitting hole 2a.

The sound emitting hole 2a communicates with a resonance chamber 3 within the body 1. In the resonance chamber 3, a piezo-electric vibrator 4 is held between the back 2 and a holder 5. The piezo-electric vibrator 4 is, as is well known, formed by way of putting a piezo-electric element 42 on a vibrating plate 41, the members 41, 42 forming an alarm buzzer.

To the rear of the holder 5 (i.e. to the right as seen in Figure 1) there is disposed a circuit board 6. A positioning or support rod 71, which is integrally formed with a base plate 7, passes through a through hole 6b bored in the circuit board 6. The front end of the positioning rod 71 is, as shown in Figure 4, disposed in a through hole 5a in the holder 5.

An electrically conductive coil spring 8, which is wound around the outer periphery of the positioning rod 71, has an annular end or base portion 8a (Figure 3) which is positioned in electrical and mechanical contact with a circuit pattern 6a of the circuit board 6. The support rod 71 thus extends axially through the coil spring 8. The front end of the coil spring 8 comprises a radially extending portion 8b which extends from a central portion of the coil spring 8 and towards the centre of the latter. The coil spring 8 also has an axially extending non-annular contact portion 8c which extends centrally of the coil spring 8. The front surface of the axially extending contact portion 8c is, as shown in Figure 4, positioned in mechanical and electrical contact with the outer surface of the piezo-electric element 42 in the form of a point contact.

The positioning rod 71, which serves as a means for positioning the coil spring 8, is, as shown in Figures 4 and 5, provided with an axially extending groove 71a in which the radially extending portion 8b and the axially extending portion 8c of the coil spring 8 are disposed. The front surface of the positioning rod 71 is, as shown in Figures 5 and 6, formed by two guide surfaces 71b which slope in opposite directions with respect to the groove 71a. The

groove 71a, as shown in Figure 5, is arranged to be disposed substantially in alignment with the outer periphery of the piezo-electric element 42. Therefore, by keeping the clearance between the radially extending portion 8b and the inner surface of the groove 71a small, the radial movement of the coil spring 8 can be prevented. Furthermore, the axially extending contact portion 8c of the coil spring 8 can be brought into firm contact with the outer periphery of the piezo-electric element 42 of the piezo-electric vibrator 4 in the form of a point contact.

As shown in Figure 1, a dial 9 is secured to the base plate 7, and a front cover 10 is provided in front of the dial 9.

When the coil spring 8 is fitted from the front end of the positioning rod 71, if the radially extending portion 8b of the coil spring 8 rides over the front surface of the positioning rod 71, it slides along the sloping guide surfaces 71b, whereby the radially extending portion 8b can be smoothly fitted in the positioning groove 71a. As a result, the coil spring 8 can be easily and quickly fitted.

Figure 7 illustrates another embodiment according to the present invention wherein the positional relationship between a circuit board 6A and a base plate 7A is arranged inversely to that described in the embodiment of Figures 1-6. Namely, a positioning hole 71A which serves as positioning means is provided in the base plate 7A, the coil spring 8 being disposed in the positioning hole 71A. The reference numeral 61A indicates a circuit pattern.

In the constructions shown in the drawings, since the front end of the axially extending contact portion 8c of the coil spring 8 can be positioned in contact with the outer periphery of the piezo-electric element 42 in the form of a point contact, an adequate sound pressure can be obtained from the alarm buzzer 41, 42. Furthermore, since guide surfaces 71b are provided at the front end of the positioning rod 71, the coil spring 8 can be easily and quickly mounted.

C L A I M S

1. A vibrator assembly comprising a piezo-electric vibrator; a circuit board; and an electrically conductive coil spring having an annular end portion which is in electrical and mechanical contact with the circuit board, the coil spring having an axially extending end portion which is substantially in point contact with the piezo-electric vibrator and which is connected to a central portion of the coil spring by a substantially radially extending portion.

2. A vibrator assembly as claimed in claim 1 in which the coil spring is mounted on a support rod which extends axially through the coil spring.

3. A vibrator assembly as claimed in claim 2 in which the support rod is provided with an axially extending groove in which the said axially extending end portion and the said radially extending portion are disposed.

4. A vibrator assembly as claimed in claim 2 or 3 in which the support rod is provided with guide means to guide the radially extending portion into position when the coil spring is mounted on the support rod.

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5. A vibrator assembly as claimed in claim 4 in which the guide means comprise guide surfaces which slope with respect to each other.

6. A vibrator assembly as claimed in any preceding claim in which the said axially extending end portion contacts the piezo-electric vibrator adjacent its outer periphery.

7. A vibrator substantially as hereinbefore described with reference to and as shown in Figures 1-6 or Figure 7 of the accompanying drawings.

8. A timepiece provided with a vibrator assembly as claimed in any preceding claim, the piezo-electric vibrator being that of a buzzer of the timepiece.

9. An electricity supply structure for a piezoelectric vibrator comprising:

a circuit board;

a coil spring, having a base portion which is positioned in contact with said circuit board, and in which a portion extending toward its center is provided at the front end thereof, and in which a rising contact portion which stands

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at a central portion of said coil spring is provided in said extending portion;

a piezoelectric vibrator with which a front end of said rising contact portion of said coil spring is positioned in contact; and

means for positioning said coil spring.