

PATENT SPECIFICATION

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(54) OSCILLATOR

(71) We, KABUSHIKI KAISHA DAINI SEIKOSHA, a Japanese body corporate 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 concerns an oscillator, e.g. for use in an electronic timepiece.

According to the present invention, there is provided an oscillator comprising a piezo-electric oscillator member of tuning fork shape, a sealed housing within which the oscillator member is mounted and a support member which constitutes a wall of the sealed housing, the support member being secured to a portion of at least one lead terminal, the or each lead terminal being longitudinally aligned with the oscillator member and being electrically and mechanically secured to an electrode of the latter, the oscillator member being carried by the support member solely by reason of the connection of the oscillator member to the lead terminal or terminals.

In contrast therefore, to the prior art, the oscillator member does not have to be carried from the support member by way of separate support leads which are additional to the lead terminal or terminals. Thus the present invention eliminates unnecessary parts and makes it easier to assemble the oscillator.

The oscillator member preferably has two electrodes which are each connected to a respective lead terminal carried by the support member.

The two electrodes may be disposed on the same side of the oscillator member.

Alternatively, the two electrodes may be disposed on opposite sides respectively of the oscillator member. In this case, the portions of the two lead terminals which are secured to the support member may lie

in a common plane which is parallel to and disposed between planes in which the two electrodes are disposed.

The invention also comprises an electronic timepiece provided with an oscillator as set forth above.

The invention further comprises a method of assembling an oscillator comprising securing a portion of at least one lead terminal to a support member, and mechanically and electrically securing an electrode or electrodes of a piezo-electric oscillator member of tuning fork shape to the lead terminal or terminals so that the oscillator member is carried by the support member solely by reason of the connection of the oscillator member to the lead terminal or terminals.

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

Figures 1A and 1B are respectively a vertical and a horizontal cross-section through a first oscillator known to the Applicants,

Figures 2A and 2B are respectively a vertical and a horizontal cross-section through a second oscillator known to the Applicants,

Figures 3A and 3B are respectively a vertical and a horizontal cross-section of a first embodiment of an oscillator according to the present invention,

Figures 4A and 4B are respectively a vertical and a horizontal cross-section of a second embodiment of an oscillator according to the present invention, and

Figures 5A and 5B are respectively a vertical and a horizontal cross-section of a third embodiment of an oscillator according to the present invention.

Terms such as "vertical", "horizontal", "upper" and "lower" as used in this specification, are to be understood to refer to directions as seen in the accompanying

drawings.

In Figures 1A and 1B there is shown an oscillator known to the Applicants comprising a housing 1 which is closed at one end by a wall 2. Mounted within the sealed interior of the housing 1 is a small piezo-electric oscillator member 3 of tuning fork shape, the oscillator 3 having a base portion 3a and forks 3b, 3c which extend from the base portion 3a.

The oscillator 3 is provided with an electrode 3d which is electrically connected to a lead terminal 4 by way of a wire 5 which is bonded to the lead terminal 4 and electrode 3d the lead terminal 4 extending through and being supported by the wall 2.

The oscillator 3 is supported within the housing 1 by means of support members 6a, 6b each of which comprises a spring metal member 7 which extends longitudinally through the wall member 2, a longitudinally extending spring metal member 8 which is secured to the base portion 3a of the oscillator 3, and a transversely extending tie member 9 which interconnects the longitudinally extending members 7, 8. The support members 6a, 6b protect the oscillator 3 from shock in that they allow the latter to move relatively to the housing 1.

The oscillator shown in Figures 1A and 1B, although intended for use in an electronic timepiece such as a wrist watch, is such that it is difficult to miniaturise it, while the extent to which the oscillator member 3 is protected from shock is not always adequate. Indeed, if the oscillator is dropped, its oscillating frequency is liable to deviate from its intended frequency. Moreover, the use of a lead terminal 4 separate from the support members 6a, 6b involves the use of an unnecessary number of parts and therefore increases the time taken and hence the cost of assembly.

The construction of Figures 2A and 2B, which is also known to the Applicants, is generally similar to that of Figures 1A and 1B and will not therefore be described in detail, like reference numerals indicating like parts. In the construction of Figures 2A and 2B, however, the support members 6a, 6b are constituted by two interconnected spring metal members 10, 11 only.

In Figures 3A and 3B there is shown a first embodiment of an oscillator according to the present invention for use in a small, shock-resistant electronic watch or the like, the oscillator being generally similar in construction to that of Figures 1A and 1B and not therefore being described in detail, like reference numerals indicating like parts.

In the construction of Figures 3A and 3B, however, the oscillator member 3 is provided with electrodes 12a, 12b which extend respectively onto the forks 3b, 3c and

each of which is disposed on the upper side of the oscillator member 3, each of the electrodes 12a, 12b extending onto part of of the base portion 3a. The oscillator member 3 abuts a wall member 13 of insulating material which is mounted within a tubular member 14, the tubular member 14 being mounted within and secured to the housing 1. The wall member 13 may be made of glass, the wall member 13 and tubular member 14 constituting one end wall of the housing 1 and acting to seal the interior of the latter. Extending longitudinally through and sealed to the wall member 13 are lead terminals 15a, 15b. The lead terminals 15a, 15b are longitudinally aligned with the oscillator member 3 and are electrically and mechanically secured to the electrodes 12a, 12b respectively. The arrangement is such that the oscillator member 3 is carried by the wall member 13, which thus constitutes a support member therefor, solely by reason of the connection of the oscillator member 3 to the lead terminals 15a, 15b. Moreover, in the construction of Figures 3A and 3B, the oscillator member 3 is directly connected to and secured to the lead terminals 15a, 15b in contrast to the arrangements shown in Figures 1A and 1B and Figures 2A and 2B in which the connection is by way of wires 5.

The lead terminals 15a, 15b are tightly secured to the electrodes 12a, 12b by means of electrically conductive adhesive 16a, 16b such as solder, the electrodes 12a, 12b being soldered to the lead terminals 15a, 15b at the base portion 3a of the oscillator member 3. If it is desired to increase the strength of the connection between the lead terminals 15a, 15b and the oscillator 3, the said solder may be replaced by another organic or inorganic adhesive.

The construction of Figures 3A and 3B may be assembled by forming the parts 13, 14, 15a, 15b together, positioning the oscillator member 3 in a contact with the wall member 13, soldering the lead terminals 15a, 15b to the electrodes 12a, 12b so that the oscillator member 3 is carried by the wall member 13 solely by reason of the connection of the oscillator member 3 to the lead terminals 15a, 15b, and assembling this construction to and sealing it to the housing 1.

As will be appreciated, the construction of Figures 3A and 3B does not involve the use of support members 6a, 6b, nor does it involve the use of wire bonding techniques. It is thus easier to assemble than the constructions of Figures 1A and 1B, or 2A and 2B.

In Figures 4A and 4B there is shown a second embodiment of an oscillator according to the present invention, the construction of this second embodiment being

generally similar to that of Figures 3A and 3B and for this reason not being described in detail, like reference numerals indicating like parts.

- 5 In the construction of Figures 4A and 4B, however, the electrodes 12a, 12b are replaced by electrodes 12c, 12d each of which extends both onto the base portion 3a and onto the forks 3b, 3c of the oscillator 3, the electrodes 12c, 12d being respectively disposed on the upper and lower surfaces respectively of the oscillator member 3. Lead terminals 15c, 15d are employed which are respectively disposed in substantially the same planes as the electrodes 12c, 12d.

In Figures 5A and 5B there is shown a third embodiment of an oscillator according to the present invention which is generally similar to that of Figures 4A and 4B and which for this reason will not be described in detail, like reference numerals indicating like parts.

- 20 In the construction of Figures 5A and 5B, however, lead terminals 17a, 17b are employed each of which has a portion 18 which extends through and is secured to the wall member 13 and which lie in a common plane which is parallel to and disposed between the planes in which the electrodes 12c, 12d are disposed. Each of the lead terminals 17a, 17b thus has a twisted shape.

As mentioned above, since the lead terminals are directly secured to the electrodes and are used both as a mounting means and as electrical connectors, it is not necessary to use other supports for the oscillator such as shock resistant springs.

40 WHAT WE CLAIM IS:

1. An oscillator comprising a piezo-electric oscillator member of tuning fork shape, a sealed housing within which the oscillator member is mounted and a support member which constitutes a wall of the sealed housing, the support member being secured to a portion of at least one lead terminal, the or each lead terminal being longitudinally aligned with the oscillator

member and being electrically and mechanically secured to an electrode of the latter, the oscillator member being carried by the support member solely by reason of the connection of the oscillator member to the lead terminal or terminals.

2. An oscillator as claimed in claim 1 in which the oscillator member has two electrodes which are each connected to a respective lead terminal carried by the support member.

3. An oscillator as claimed in claim 2 in which the two electrodes are disposed on the same side of the oscillator member.

4. An oscillator as claimed in claim 2 in which the two electrodes are disposed on opposite sides respectively of the oscillator member.

5. An oscillator as claimed in claim 4 in which the portions of the two lead terminals which are secured to the support member lie in a common plane which is parallel to and disposed between planes in which the two electrodes are disposed.

6. An oscillator substantially as hereinbefore described with reference to and as shown in Figures 3A and 3B, or in Figures 4A and 4B, or in Figures 5A and 5B of the accompanying drawings.

7. An electronic timepiece provided with an oscillator as claimed in any preceding claim.

8. A method of assembling an oscillator as claimed in claim 1 comprising securing a portion of at least one lead terminal to a support member, and mechanically and electrically securing an electrode or electrodes of a piezo-electric oscillator member of tuning fork shape to the lead terminal or terminals so that the oscillator member is carried by the support member solely by reason of the connection of the oscillator member to the lead terminal or terminals.

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member and being electrically and mechanically secured to an electrode of the latter, the oscillator member being carried by the support member solely by reason of the connection of the oscillator member to the lead terminal or terminals.

2. An oscillator as claimed in claim 1 in which the oscillator member has two electrodes which are each connected to a respective lead terminal carried by the support member.

3. An oscillator as claimed in claim 2 in which the two electrodes are disposed on the same side of the oscillator member.

4. An oscillator as claimed in claim 2 in which the two electrodes are disposed on opposite sides respectively of the oscillator member.

5. An oscillator as claimed in claim 4 in which the portions of the two lead terminals which are secured to the support member lie in a common plane which is parallel to and disposed between planes in which the two electrodes are disposed.

6. An oscillator substantially as hereinbefore described with reference to and as shown in Figures 3A and 3B, or in Figures 4A and 4B, or in Figures 5A and 5B of the accompanying drawings.

7. An electronic timepiece provided with an oscillator as claimed in any preceding claim.

8. A method of assembling an oscillator as claimed in claim 1 comprising securing a portion of at least one lead terminal to a support member, and mechanically and electrically securing an electrode or electrodes of a piezo-electric oscillator member of tuning fork shape to the lead terminal or terminals so that the oscillator member is carried by the support member solely by reason of the connection of the oscillator member to the lead terminal or terminals.

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