United States Patent

Choffat

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[54] PIEZOELECTRIC RESONATOR

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[30] **Foreign Application Priority Data**

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[51] **Int. Cl.** **H01v 7/00**

[58] **Field of Search** 310/8.5, 8.6, 9.1–9.4, 310/9.6, 25

[56] **References Cited**

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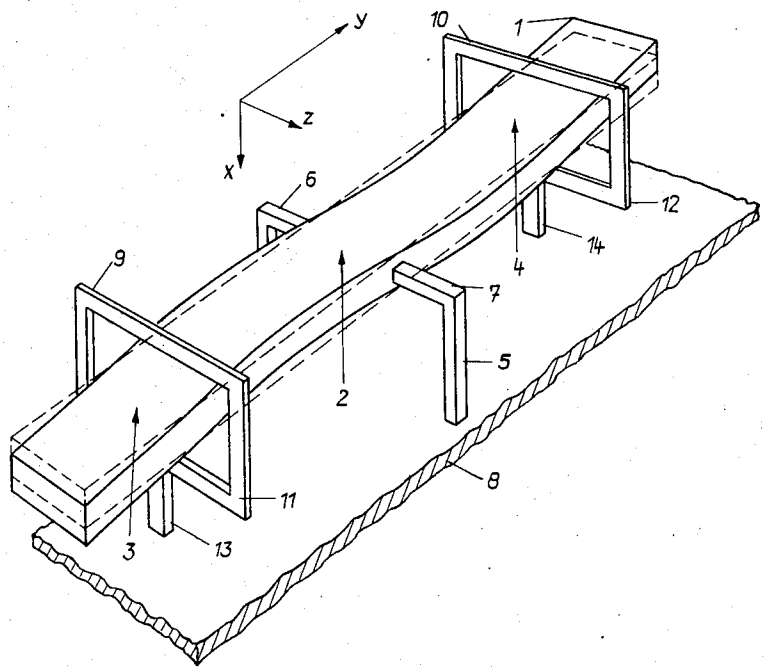
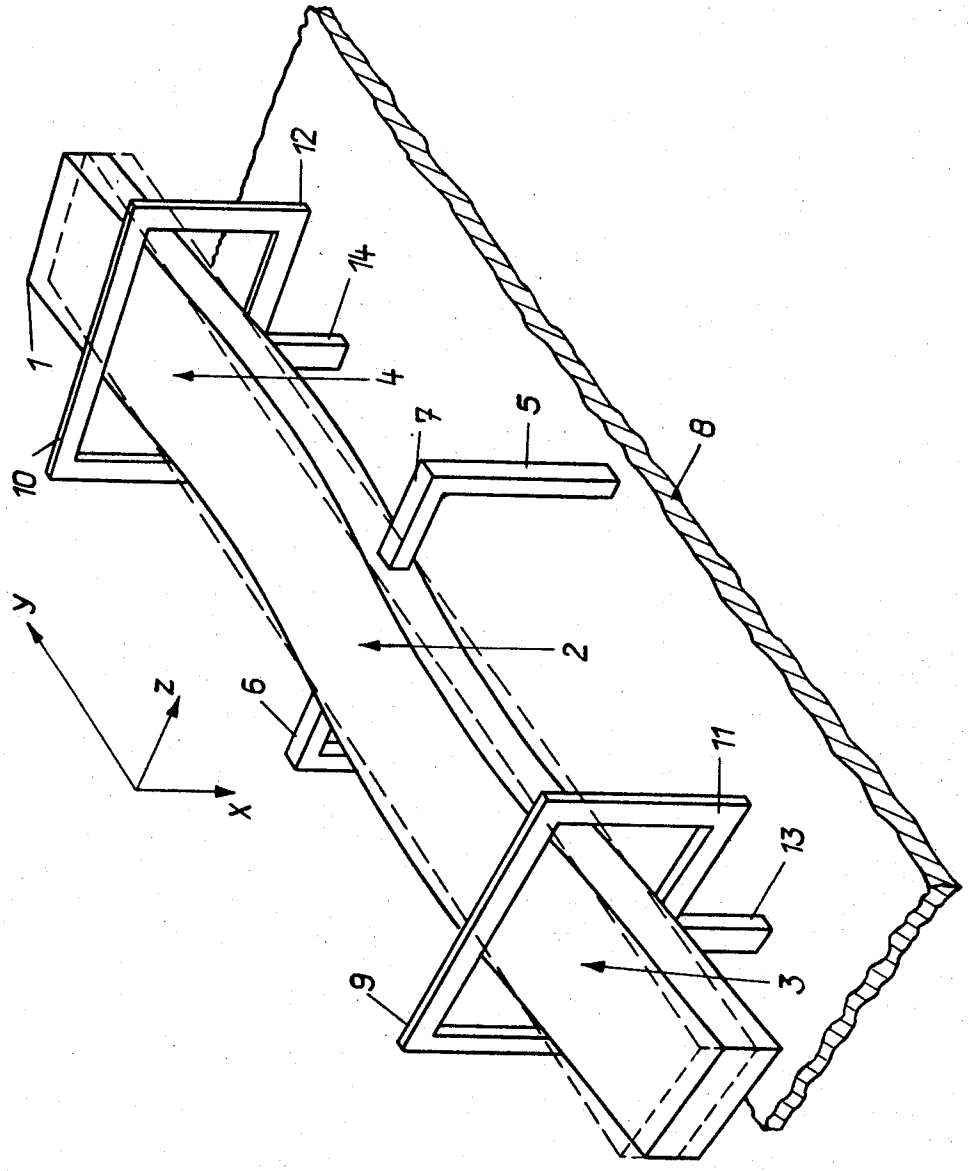
[57] **ABSTRACT**

A piezoelectric resonator comprises a crystal blade working by flexion and having at least two nodal points, suspension means supporting the blade at one nodal point, and means for limiting movement of the blade located adjacent to at least one further nodal point.

4 Claims, 1 Drawing Figure

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PIEZOELECTRIC RESONATOR

BACKGROUND OF THE INVENTION

This invention relates to piezoelectric resonators having a crystal blade working by flexion.

In these resonators, the blade is generally suspended at two lateral nodal points, which ensures good stability of the suspension. However, this manner of suspending the blade has an important drawback since in the case where the crystal undergoes variations of temperature, the distance between the two nodal points varies and, consequently, the assembly of the suspended crystal is submitted to stresses which, in limiting cases, perturb the frequency and absorb the amplitude of oscillation of the crystal.

By suspending the blade at a single nodal point, for example the median nodal point, instead of at two, the frequency stability would be improved, but in the case of a shock on the casing, the displacements executed by the blade would be much greater than in the case of suspension at two lateral nodal points.

SUMMARY OF THE INVENTION

The aim of the invention is to eliminate these drawbacks and to provide a resonator in which the stability is improved without reducing safety in the case of shocks.

According to the invention, a piezoelectric resonator comprises a crystal blade working by flexion and having at least two nodal points, suspension means supporting the blade at one nodal point, and means for limiting movement of the blade located adjacent to at least one further nodal point.

In operation, in the case of a small acceleration acting on the crystal, only the suspension means are effected while for a stronger acceleration the limiting means come into action.

In the proposed construction, the crystal is not submitted to any constraint and can thus vibrate freely. Also, in the case of a shock, the limiting device prevents an over-great amplitude of movement, without perturbing the frequency, since the part of the blade coming into contact with the limiting device vibrates by a small amount because it is located at a nodal point. The oscillation of the crystal is thus not stopped at the moment when the blade enters into contact with the limiting device.

DESCRIPTION OF A PREFERRED EMBODIMENT

The single FIGURE of the accompanying drawings shows, schematically and by way of example, an embodiment of the resonator according to the invention.

The resonator comprises a piezoelectric quartz blade **1** the rest position of which is shown in broken lines and an oscillating position in full lines. As is seen, the blade vibrates with an X–Y flexion, in second harmonic. There is thus formed a central nodal point **2** and two lateral nodal points **3** and **4**. These two lateral nodal points **3** and **4** are in fact pseudo-nodal points since they can evidently shift along the Y axis; we will, however, continue to denote them by the term nodal point.

The piezoelectric blade **1** is carried by suspension means **5** comprising two inverted L-shaped members **6** and **7**. Each of these members **6** and **7** is fixed, at one of its ends, to an edge of the blade **1** on the transversal axis corresponding to the central nodal point **2**, and its other end to a wall **8** of a capsule enclosing the piezoelectric blade **1**, for example under vacuum.

The resonator also comprises two limiting members **9** and **10** each having a rectangular frame **11**, **12** respectively and a stem **13**, **14** respectively the free end of which is fixed to the wall **8**. These two limiting members **9** and **10** are respectively located surrounding the blade about the nodal points **3** and **4**.

In the case of a low acceleration of the wall **8** not sufficient for the blade **1** to come into contact with the limiting members **9** and **10**, only the suspension means **5** are effected. If, however, the acceleration of the wall **8** is sufficient to cause the blade **1** to contact the limiting members **9** and **10**, the latter come into operation to limit the amplitude of vibration of the blade.

These limiting members can be deformable, for example in a plastics material, in which case they assume the function of absorbers or, on the other hand, they can be rigid, in which case they simply limit the amplitude of flexion.

The limiting members **9** and **10** act on the blade **1** in zones where the movement of the blade is minimum, so that the action of the limiting members on the frequency and amplitude of oscillation is also minimum.

For the same reasons, the coming into contact between the blade and the limiting members takes place at the minimum relative speed. The resulting impact between the blade and the limiting members is thus minimal.

If, upon coming into contact, the mechanical characteristics of the blade are locally modified (for example, if the blade is damaged by the limiting members), the definite effect of this modification on the frequency is also minimal, since the contact takes place at a part of the blade (nodal point) where the vibrations are the smallest. Oscillation of the blade is thus not stopped upon contact.

What is claimed is:

1. A piezoelectric resonator comprising a crystal blade working by flexion and having a central nodal point and at least two lateral nodal points, suspension means supporting the blade at the central nodal point, and means for limiting movement of the blade located adjacent to each of the two lateral nodal points.

2. A resonator as claimed in claim **1**, in which the blade resonates in second harmonic.

3. A resonator as claimed in claim **1**, in which the limiting means comprises a member having an aperture surrounding the blade at the lateral nodal points.

4. A resonator as claimed in claim **3**, in which the said member is deformable upon contact with the blade.

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