May 9, 1933. H. STRAUBEL 1,908,572

DISK SHAPED PIEZO ELECTRIC OSCILLATOR

Filed Nov. 24, 1931

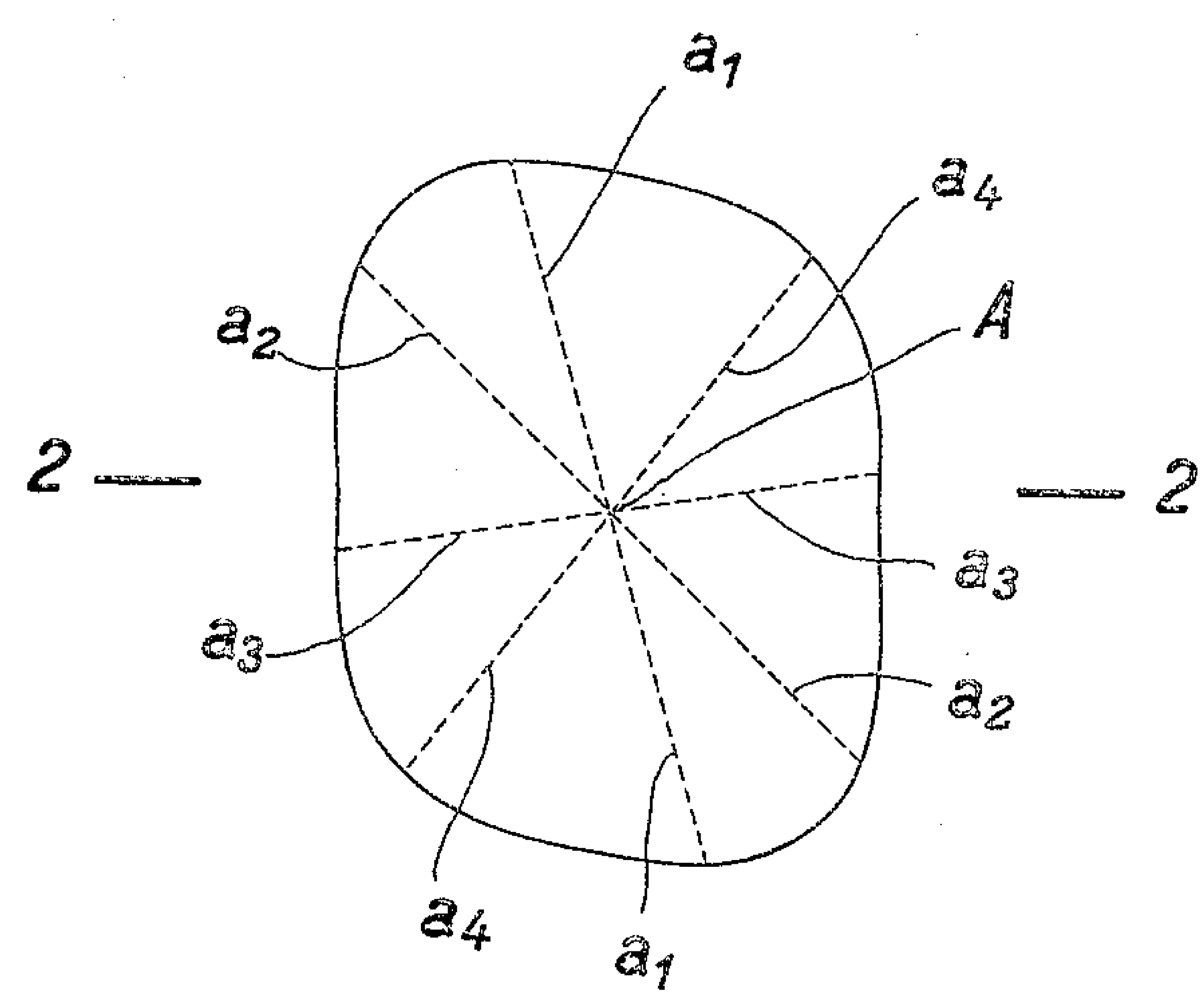

Fig. 1

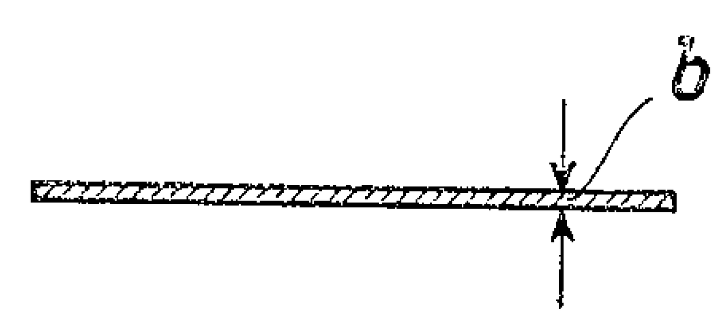

Fig. 2

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UNITED STATES PATENT OFFICE

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DISK-SHAPED PIEZO-ELECTRIC OSCILLATOR

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The piezo-electric oscillators (or resonators) generally used in technics are circular or rectangular disks.

As the modulus of elasticity is governed by the direction, the frequencies of oscillators of this kind are not uniform in the plane of the disk, which is proved for instance by the irregularity in the vibration of the surfaces of such disks.

Uniform frequencies being of advantage in some kinds of application of such oscillators, the invention aims at providing a new means which overcomes the said irregularity.

This new means consists in giving the oscillator a form which compensates the disparities of the modulus of elasticity existing in the different directions.

In the different directions of diameter, the frequencies are direct proportional to the square roots of the moduli of elasticity and inversely proportional to the diameter lengths and, as a consequence, the frequency can be given an ample independence of the direction by making the lengths of these diameters proportional to the square roots of the moduli of elasticity.

The resulting form of the disk represents a centre figure, in other words a figure containing a point which bisects all straight lines passing through it and having their end points at the edge of the disk.

It can be proved by way of experiment that the desired effect is obtained to a great extent.

The conditions of vibration of the described disk-shaped oscillator are especially favourable when the frequency of the vibrations in the diameter directions is equal to the frequency of the vibration perpendicular thereto (thickness vibration) or when one of these kinds of vibration represents a higher harmonical of the other.

The accompanying drawing, which illustrates an example of the invention, shows an oscillator of quartz. Figure 1 is a view and Figure 2 a cross section through line 2—2 in Figure 1.

As shown in Figure 1, the oscillator is given such a form that all straight lines passing through the point A (some of which are indicated by dots) are bisected by this point A. The halves a_1, a_2 . . . of these straight lines have such lengths that they are proportional to the square roots of the moduli of elasticity in the respective directions. The thickness b, which is shown in Figure 2, has such a dimension that the ratio of the thickness h and the square root of the modulus of elasticity in the thickness direction is an even multiple of the ratio of any of the lengths a and the square root of the modulus of elasticity in the respective direction. Hence the frequency of the thickness vibration is a higher harmonical of the frequency of the oscillations in the directions a.

The oscillator shown in the drawing is a so-called Curie cut, that is to say an oscillator cut out of a crystal in such a manner that the electric axis is at right angles to the plane of the drawing in Figure 1 and that the optical as well as the crystallographic axis lie in this plane.

I claim:

1. A disk-shaped piezo-electric oscillator or resonator, the plane bounding surfaces of this oscillator or resonator forming a figure in which all straight lines passing through a point in the said figure are bisected by this point, the lengths of the said straight lines from the said point to the edge of the figure being proportional to the square roots of the moduli of elasticity in the respective directions.

2. In a disk-shaped piezo-electric oscillator or resonator according to claim 1, the thickness having such a dimension that the ratio of the thickness and the square root of the modulus of elasticity in the thickness direction is an even multiple of the ratio of any of the said lengths and the square root of the modulus of elasticity in the respective direction.

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