April 10, 1934.

W. G. CADY

1,954,238

MOUNTING OF PIEZO ELECTRIC RESONATORS

Filed Oct. 29, 1925

Fig. 1

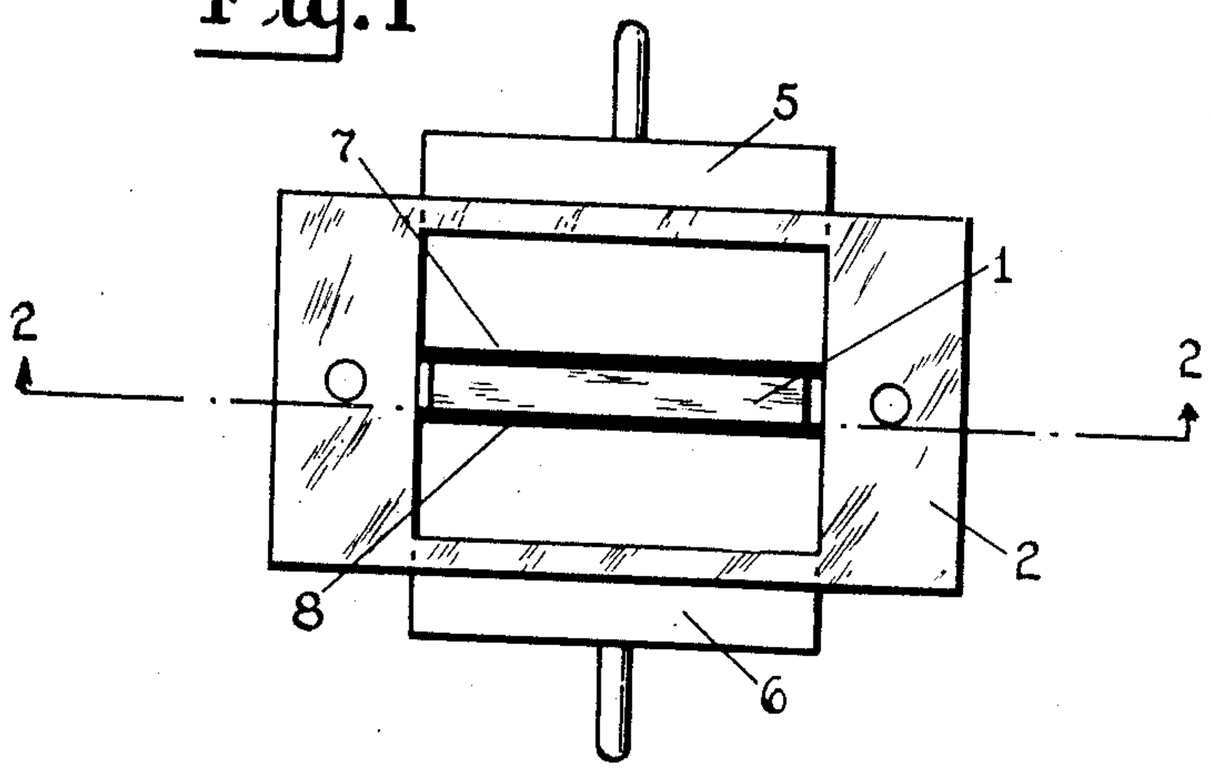


Fig. 2

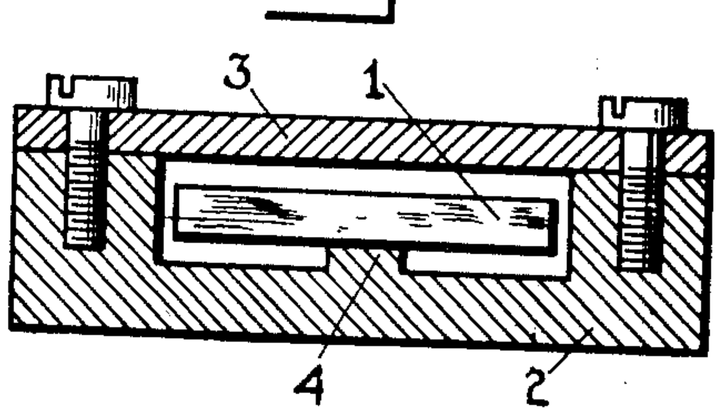


Fig. 3

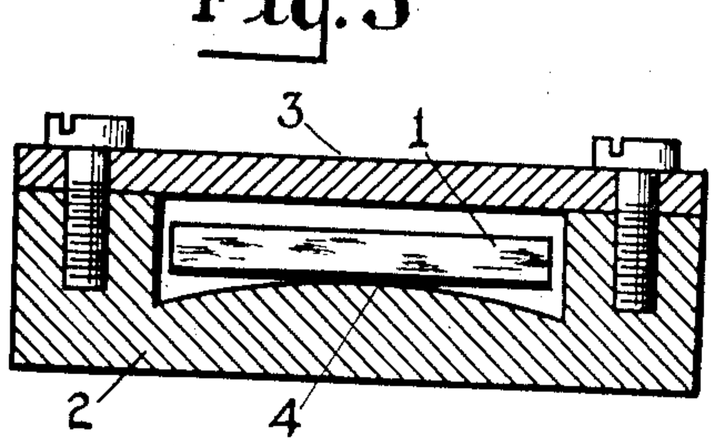
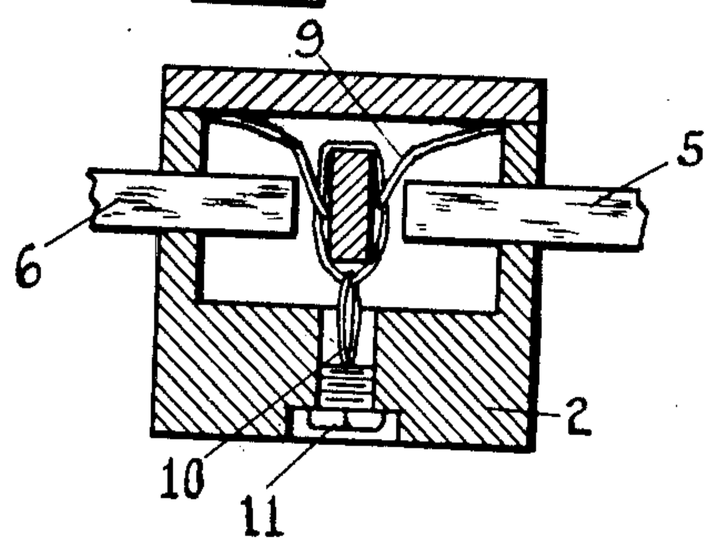


Fig. 4



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1,954,238

MOUNTING OF PIEZO-ELECTRIC RESONATORS

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Application October 29, 1925, Serial No. 65,523

1 Claim. (Cl. 171—327)

This invention relates to the mounting of piezo-electric resonators and deals more specifically with the provision of a housing for the crystal to provide for substantially undamped vibration of the crystal. In my paper in "The Proceedings of the Radio Engineers," April 19, 1922, pages 106 and 107 and also in my paper in the Journal of the "Optical Society" volume 10, of April 1925, pages 7 to 9 I have referred to the use of piezo-electric resonators. In the resonators as used in these above referred to papers I simply laid the piezo-electric crystal on edge in a narrow, flat, bottom pocket with small air spaces between the crystal and the metal coatings. This structure has been found to be open to the following objections:

Firstly.—When the crystal lies with its full length in contact with the bottom of the pocket, its freedom of motion is somewhat hampered, and this effect will become worse if dust settles in the pocket, or if the sides and bottom of the pocket become worn away by the sharp edges of the quartz in any manner.

Secondly.—The natural frequency of vibration of the quartz depends to a minute extent on its position in the pocket, being slightly lower if the quartz lies in contact with one of the metal coatings. I have explained this more fully in the above referred to papers. This trouble may be reduced to a minimum by making the air space exceedingly small on each side of the crystal, but this involves the difficulty of unduly damping the vibrations of the crystal.

It is an object of this invention to mount the crystal in a proper housing whereby the contact of the crystal with the housing is reduced and the natural frequency of vibration of the crystal is substantially unaffected. The manner of carrying out this invention will be readily understood from the following description taken in connection with the drawing in which:

Fig. 1 is a plan view of the resonator with the cover plate removed.

Fig. 2 is a longitudinal section taken on the line 2—2 of Fig. 1.

Fig. 3 is a similar section to that shown in Fig. 2 showing a modification of the supporting surface of the housing.

Fig. 4 is a transverse section of the resonator showing a modified form for supporting the crystal.

Referring to the drawing, 1 indicates the piezo-electric body which may be constructed of any of the materials referred to for such purposes in my prior Patent No. 1,450,246. 2 represents the insulating base of the box like structure having the raised portion 4 which supports the crystal substantially at the center. However, it is not essential in the operation of this device that the crystal be supported at any one particular place, and the crystal may alternatively be supported by two or more raised portions placed at the points where nodes of motion occur in the vibration of the crystal. As a rule a piezo-electric body in common with other elastic solids, is capable of being stimulated into longitudinal vibration at higher frequencies or overtones, which frequencies are approximately integral multiples of the fundamental frequency. When a piezo-electric body is undergoing longitudinal vibration at its fundamental frequency, there is at the center, if the ends are free to vibrate, a node of motion and a loop of compression; while at the ends there are loops of motion and nodes of compression. When the crystal is vibrating at the second harmonic there will be two points along the length of the crystal at which nodes of motion occur; and for the third harmonic there will be three such points. The vibration of piezo-electric bodies at various overtones has been described in my paper in the Journal of the Optical Society, vol. 10, April 1925. See page 8 of this article. For the purposes of this disclosure I merely wish to point out that I am not limited to a specific position for the crystal supporting element in the housing; but rather the position of such element would be governed by the mode of vibration of the crystal. In the drawing I have shown the support most suitably positioned for a crystal designed to vibrate at its fundamental. In my co-pending application Serial No. 59751, filed Oct. 1, 1925, I have described the action of the crystal when it vibrates at frequencies other than its fundamental. In carrying out this invention it may be found desirable to support the crystal at points where the nodes of motion, as distinguished from the points where the loops of motion occur.

3 indicates a suitable cover plate to protect the crystal. The metallic coatings 5 and 6 are attached to the housing in such a manner as to be in proximity to the crystal 1. To the sides of the pocket are attached strips 7 and 8 of mica, glass, composition or other insulating material between which sufficient space is left for freedom of movement of the crystal. The strips 7 and 8 may also be omitted without departing from the spirit of this invention. The crystal may be positioned in a horizontal plane with respect to the metallic plates by means of the strips 7 and 8, that is 7 and 8 may be used to maintain the crystal ap-

proximately midway between the coatings 5 and 6.

In the modification shown in Fig. 4 I have provided a thread member 9 which is looped about the central portion of the crystal and supported from the sides of the housing 2. In order to properly aline the crystal between the metal plates I provide the additional thread 10 which is attached to the rotatable member 11, journalled in the bottom of the insulating base 2. By rotating the member 11, the angular relation of the crystal with respect to the housing may be conveniently altered.

The description and explanation herein contained refers more specifically to resonators prepared from piezo-electric crystals. Nevertheless, the essential points apply equally well to electro-mechanical vibrators of any form as long as they are adapted to being stimulated into vibration upon application of a suitable alternating electric field.

Having thus described my invention what I claim is:

In apparatus of the character described, a horizontally disposed housing of insulating material, said housing having a depression therein, said depression having a curved convex surface, a flat piezo-electric crystal resting upon said surface, a cover of insulating material fixed to said housing and enclosing said crystal and depression, a pair of metallic electrodes extending through the sides of said housing and facing said piezo-electric crystal, and strips of insulating material attached to said electrodes and between said crystal and said electrodes.

WALTER G. CADY.