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SELF LEVELING MOUNTING FOR PIEZOELECTRIC ELEMENTS

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Fig. 1.

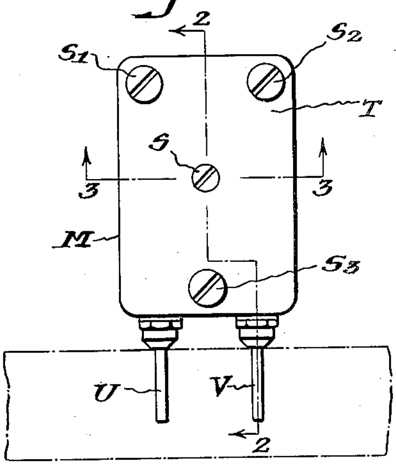


Fig. 2.

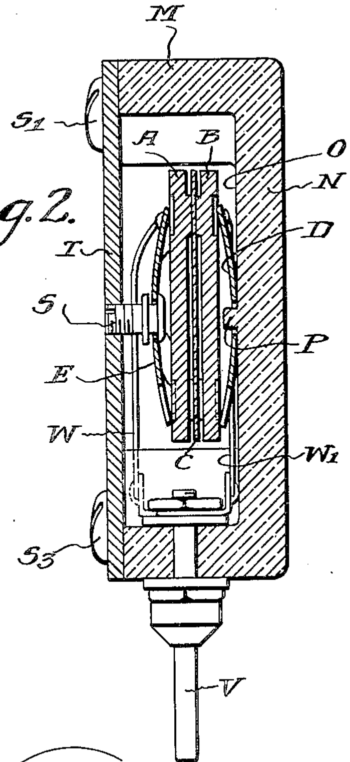


Fig. 3.

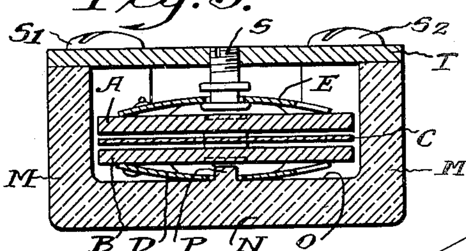
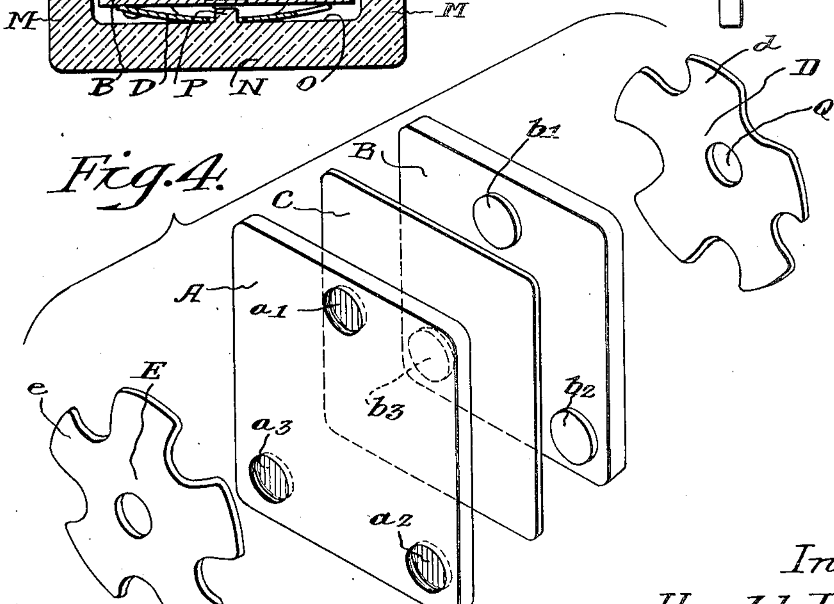


Fig. 4.



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SELF-LEVELING MOUNTING FOR PIEZO-ELECTRIC ELEMENTS

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11 Claims. (Cl. 171—327)

This invention relates to the piezo-electric art, particularly to a method of, and apparatus for, mounting a piezo-electric crystal element.

In accordance with the prior art a crystal may be mounted in various ways. It may be simply arranged in face to face contact between two plate like electrodes, the only pressure exerted upon the crystal being that of the upper plate. It has been found that crystals mounted in accordance with this "gravity method" are subject to variations in operation when subjected to shocks or tremors tending to cause relative movement between the crystal and its electrodes. To obviate this disadvantage it has been proposed to clamp the crystal by positive pressure exerted against the outer surfaces of the electrode plates. Piezo-electric crystals are, however, extremely sensitive in the oscillation performance to the pressure exerted thereon. Pressure in excess of that required to prevent relative displacement of the electrode assembly tends to damp the crystal; so much so that in the presence of a definite pressure sudden failure to oscillate may occur.

While various means are known to adjust the total pressure upon a crystal, we have found that unless the pressure is evenly distributed about the crystal area localized damping may occur. In the case of width or bar oscillators this undesired condition may be obviated by mounting the crystal along a nodal axis or line of zero movement but such mountings may be less rigid than is required in everyday use and, in the case of so-called "thickness oscillators" is usually impractical because of the limited clamping area available.

It would appear that the desired rigidity might be simply obtained by mounting the crystal, say, at its four corners and applying the clamping pressure in the exact geometrical common center of the crystal and its plates. As a practical matter, however, this cannot be conveniently accomplished for the reason that it is not easy to grind perfectly flat and uniform crystals and crystal supporting surfaces.

A principal object of the present invention is to provide a self-leveling mounting for piezo-electric crystals.

Another object of the invention is to provide a crystal mounting capable of optimum performance in spite of inaccuracies in manufacture.

Another object of the invention is to provide a crystal mounting ensuring an even distribution of clamping pressure.

Another object of the invention is to provide support means rendering a piezo-electric element substantially immune to shocks and tremors.

A further object of the invention is to provide an electrode assembly for lamellar crystals wherein the crystal is supported at the minimum number of points required to define the plane of the crystal.

Other objects of the invention are to provide an inexpensive, simple and trouble-free, air-gap pressure mounting for piezo-electric crystal elements.

Still other objects will be apparent and the invention itself will be best understood by reference to the following description taken in connection with the accompanying drawing wherein:

Figure 1 is a front elevation of a socket-plug unit containing a piezo-electric crystal mounted in accordance with the invention, the casing itself being of a type known in the art,

Fig. 2 is an enlarged sectional view on the line 2—2 of Fig. 1 showing a self-leveling piezo-electric crystal mounting within the present invention.

Fig. 3 is an enlarged sectional view on the line 3—3 of Fig. 1, and

Fig. 4 is an exploded view of the crystal and its retaining members.

Referring in detail to the drawing in which like characters represent the same or corresponding parts in all figures.

In carrying the invention into effect, we provide a pair of electrode plates A, B, which are preferably substantially coextensive in length and breadth with the piezo-electric crystal C interposed therebetween. Plates A, B have a plurality of crystal supporting risers a^1, a^2, a^3, b^1, b^2, b^3, thereon. There is an air-gap on both sides of the crystal intermediate the crystal and plate surfaces, except at the several immediate points of contact.

The number of risers "a", "b" on each plate preferably corresponds to the minimum number of points required to define a plane, i. e. three and they each are preferably so arranged as to contact the crystal C at points substantially equally distant one from another. This preferred construction of the electrode plates contributes materially to the mechanical, and hence the electrical stability of the crystal because it enables the pressure upon the crystal C to be evenly distributed, even though, inadvertently the risers a^1, a^2, b^1, b^2, etc. are not each of the same exact height. In this latter connection it may be observed that, in accordance with the prior art, the crystal supporting surfaces (in this case the risers a—b) will ordinarily extend .00075 to, say .002 above the main surface of the electrode. It is commercially uneconomical to grind or lap each supporting surface to exactly the same height and we have found that in prior art mountings employing a supporting surface adjacent each corner of the electrodes that the crystal will commonly be supported at less than all of the corners so that the support is, in such cases, in fact unsymmetrical.

Referring now particularly to Figs. 2 and 3 which show an electrode assembly within the present invention encased in a socket plug unit. The casing M has an insulating body portion N conveniently recessed as at O to accommodate the crystal C, the electrode plates A, B, and the pair of oppositely located springs D, E.

These springs D, E, have outer convex and inner concave surfaces. They are preferably in the shape of rosettes, each has a plurality of petals *d, e,* symmetrically extending upwardly and outwardly from its mid-section. The "petals" or supporting arms *d, e,* of each spring preferably span a major portion of the surface of the electrode plate with which they are associated.

The electrode assembly A, B, C is effectively cradled in the bottom spring D which is adapted to rock on the inner base O of the casing M to compensate for any unevenness of force exerted through the assembly by the upper spring E. To permit of this rocking movement spring D is mounted as by means of a lug or pin P which fits loosely in perforation Q in its mid-section.

Provided the lower spring D is freely mounted to permit of compensating movement, it is not always necessary that the other spring E be similarly supported. In the drawing the upper spring E contacts a screw S which extends inwardly through the removable cover T of the unit. Spring E is loosely pivoted about the terminal of spring S; pressure may therefore be adjustably applied to the electrode assembly A, B, C, through the spring S without causing any circular force being transmitted to the upper plate A or the underlying crystal C. In some cases it has been found practical to utilize a fixed rivet, or peg, of suitable length to provide the minimum pressure required to prevent displacement of the crystal.

As indicated in the drawing the cover T of the casing M may be removably secured by means of screws S1, S2, S3. Electrical connections are made from the electrode plates A and B, preferably through springs D, E to plugs or terminals U, V by wires W, W1.

The piezo electric crystal mounting here disclosed ensures optimum performance; the pressure upon the crystal is always evenly distributed so that it will not "chatter" nor, on the other hand, be subject to undue or localized damping. It is likewise inexpensive to manufacture and its rugged self-leveling construction renders it substantially immune to tremors tending to dislocate the crystal.

What is claimed is:

1. In combination, a pair of electrode plates, a crystal interposed between said plates, a holder comprising a base portion of insulating material, and a rocker on said base upon which said electrode assembly is supported.

2. In combination, a pair of electrode plates, a crystal interposed between said plates, a holder comprising a base portion, a rocker on said base in which said electrode assembly is cradled and means for applying clamping pressure to said crystal through said electrode plates.

3. In combination, a pair of electrode plates, a crystal interposed between said plates, a holder comprising a base portion, a rocker on said base in which said electrode assembly is cradled and means for adjustably applying clamping pressure to said crystal through said electrode plates.

4. In combination, a pair of electrode plates, a crystal interposed between said plates, means for applying clamping pressure to the outer surface of one of said plates, and a freely mounted concave spring contacting the outer surface of the other of said plates and against which said clamping pressure is exerted.

5. In combination, a pair of electrode plates, a crystal interposed between said plates, a rosette spring freely mounted adjacent the outer surface of each of said electrode plates and means for applying clamping pressure to said crystal through said springs.

6. The combination with a crystal having a plane surface, of a substantially flat metal electrode having a plurality of risers thereon contacting the surface of said crystal, the number of risers on said plate corresponding to the minimum number of points required to define the plane of said surface.

7. In combination, a crystal having opposite surfaces in parallel planes, a pair of electrode plates between which said crystal is interposed, each plate having a plurality of risers thereon contacting a surface of said crystal, the number of risers on each plate corresponding to the minimum number of points required to define the plane of the crystal surface contacted thereby.

8. In combination, a crystal having opposite surfaces in parallel planes, a pair of electrode plates between which said crystal is interposed, each plate having a plurality of risers contacting a surface of said crystal, the number of risers on each plate corresponding to the minimum number of points required to define the plane of the crystal surface contacted thereby, means for applying clamping pressure to the outer surfaces of said electrode plates and means for equalizing the pressure transmitted through said risers to said crystal.

9. A piezo-electric crystal housing comprising an insulating body recessed to form a receptacle, a dish shaped spring freely pivoted on the inner base of said receptacle, an electrode plate cradled in said spring, a piezo electric crystal supported on said plate, a second electrode plate contacting said crystal and means spanning a major portion of the surface of said second electrode plate for applying clamping pressure to said piezo electric crystal.

10. Piezo electric apparatus comprising a pair of electrode plates, a piezo electric crystal interposed between said plates, means for applying clamping pressure to said apparatus, said means comprising a pair of oppositely located springs, at least one of said springs being freely mounted to distribute said pressure evenly over a major portion of the area of said crystal.

11. Method of mounting a piezo-electric crystal which comprises applying force to the crystal at spaced points about the surface thereof, and permitting the crystal to rock in order to compensate for uneven pressure thereon resulting from an unequal application of force at said spaced points.

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