May 26, 1942. P. D. GERBER 2,284,088

MOUNTING PIEZOELECTRIC ELEMENTS

Filed Dec. 29, 1939

Fig. 1.

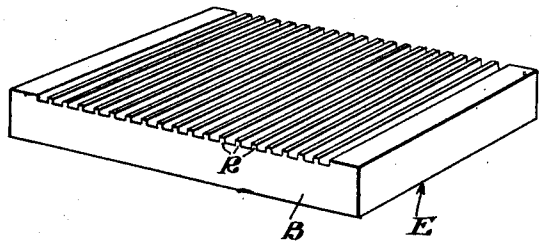


Fig. 2.

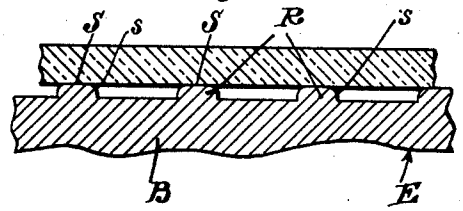


Fig. 3.

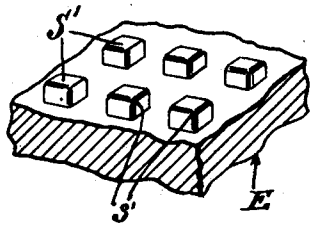
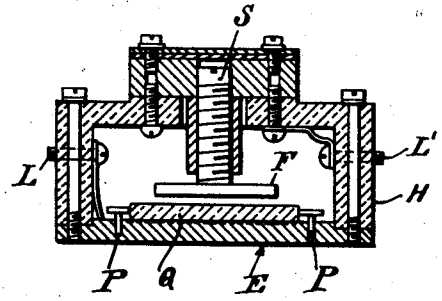


Fig. 4.



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MOUNTING PIEZOELECTRIC ELEMENTS

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3 Claims. (Cl. 171—327)

This invention relates to the art of mounting piezo-electric crystal elements.

Piezo-electric crystals are extremely sensitive to any force tending to damp their oscillations. Among the factors inhibiting optimum performance are: (*a*) clamping pressure, (*b*) friction, (*c*) adhesion, and (*d*) the accumulation adjacent the crystal of air borne dust or of minute crystalline or metal particles generated during the normal operation of the crystal by its movement on its supporting surface.

While clamping pressure can be eliminated (at least in stationary units) by mounting the crystal in an air-gap holder the heretofore proposed solutions of the other problems either give rise to other equally serious problems or are not entirely practical. By way of example, in order to reduce friction between the crystal and its supporting surface, it has heretofore been proposed to render both surfaces optically flat, but this has been found to augment the tendency of the crystal to resist starting because of the likelihood of adhesion between such highly finished surfaces.

Accordingly, an object of the present invention is to provide an improved mount for a piezo-electric crystal wherein the tendency of the crystal to resist starting due to adhesion is minimized and wherein friction between the crystal and its supporting surface is less than in comparable holders of the prior art.

Another object of the invention is to provide a holder of the character described which incorporates a dust trap.

Another object of the invention is to provide a simple inexpensive and trouble-free method and apparatus for mounting a piezo-electric element.

In the drawing wherein like reference characters designate the same or corresponding parts in all figures,

Figure 1 is a view in perspective of an electrode constructed in accordance with the principle of the invention,

Figure 2 is an enlarged fragmentary side elevational view of the electrode of Fig. 1 with a crystal supported thereon,

Figure 3 is an enlarged fragmentary view in perspective of another electrode embodying the invention, and

Figure 4 is a cross-sectional view of a holder containing a piezo-electric element and incorporating the invention.

The foregoing and other objects and advantages are achieved in accordance with the invention by mounting and vibrating a piezo-electric element upon an electrode provided with a multiplicity of discrete supports or risers thereon.

The surfaces of the risers preferably comprise flat areas or lands defining a common plane and the spaces or grooves between these spaced supports comprise "relief air channels" which prevent adhesion and also constitute an effective dust trap into which particles tending to accumulate adjacent the supported face of the crystal will fall.

The electrode E of Figs. 1 and 2 comprises a base B having a multiplicity of risers R thereon which terminate in flat surfaces S which constitute a grid-like support for the piezo-electric crystal to be supported thereon. As shown, the risers R may be in the form of oblongs which extend across the plate, but they may be of substantially any other shape or pattern. By way of example, referring to Fig. 3, they may comprise a punctiform pattern formed of small circles or squares S'. It is preferable to round or to bevel the edges of these separate supports S, S', as indicated at *s*, *s'* in Figs. 2 and 3, respectively, to eliminate any "feathers" or other irregularities which might tend to scratch the surface of polished crystal. The electrode may be conveniently formed by stamping a flat metal plate with a tool having a die face of the pattern desired, after which the supporting surface is preferably polished as with felt.

The exact depth and pitch of the risers is not critical as any appreciable quantity of air (or of other gas, if a gas filled casing is employed) beneath the crystal will obviate the tendency of its highly polished face to adhere to the supporting surfaces of the risers. The spaces between the risers, however, should be deep enough and wide enough to hold the dust or foreign particles which may fall therein when the crystal element is vibrated thereabove. The advantages of an electrode incorporating a dust trap will be apparent when it is appreciated that it is practically impossible by any washing process to entirely rid the crystal of the minute particles of abrasive which become embedded therein during the grinding operation. Electrodes having a pattern similar to that of the one shown in Figs. 1 and 2 gave satisfactory performance when the dimensions of the risers were as follows: width .05", spacing .1", depth .005" to .001".

Fig. 4 shows a simple air-gap holder wherein the base E of the housing H comprises the electrode of Figs. 1*a* and 2. The crystal Q is simply laid without clamping pressure on the

risers. A number of retaining pins P on the base define the limits of movement of the crystal in its plane of support. The other necessary electrode comprises a conventional flat surfaced metal disc F supported upon an adjusting screw S out of contact with the crystal Q. Leads L and L' provide external connections to the electrodes E and F, respectively.

Various modifications of the invention will suggest themselves to those skilled in the art. Accordingly, the foregoing is to be interpreted as illustrative and not in a limiting sense except as required by the prior art and by the spirit of the appended claims.

What is claimed is:

1. Method of mounting a piezoelectric crystal which comprises conductively supporting said crystal without clamping pressure at a multiplicity of discrete areas about an electrode face thereof.

2. Method of mounting a piezoelectric crystal which comprises conductively supporting said crystal without clamping pressure upon a multiplicity of discrete surfaces.

3. Method of operating a piezoelectric crystal having a flat face, which comprises freely supporting said face of said crystal upon a multiplicity of flat raised conductive surfaces having air channels therebetween, whereby adhesion between said flat crystal face and said multiplicity of flat supporting surfaces is prevented.

4. In combination, an electrode comprising a multiplicity of discrete conductive surfaces defining a plane supporting surface for a piezoelectric element and a second electrode mounted above said first-mentioned electrode out of pressure transfer relation with said piezoelectric element.

5. In combination, an electrode comprising a base portion and a multiplicity of spaced crystal-supporting metal risers thereon which terminate in a common plane, and a second electrode mounted above the plane of said first-mentioned electrode out of contact with said crystal.

6. In combination, an electrode comprising a base portion and a multiplicity of spaced crystal-supporting risers thereon comprising beveled metal surfaces terminating in a common plane, and a second electrode mounted above said common plane out of contact with said crystal.

7. An electrode of the character described comprising a conductive base having a multiplicity of parallelly arranged conductive lands and grooves thereon.

8. The invention as set forth in claim 7 and wherein said multiplicity of conductive lands comprise a punctiform-supporting surface for a piezoelectric element.

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