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S. A. BOKOVOY ET AL

2,078,229

MOUNTING FOR PIEZOELECTRIC ELEMENTS

Filed Dec. 31, 1935

FIG. 1.

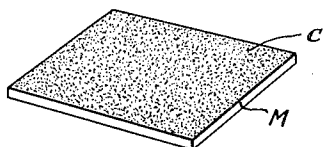


FIG. 2.

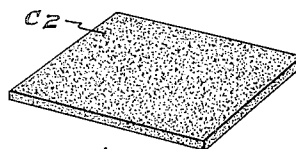


FIG. 3.

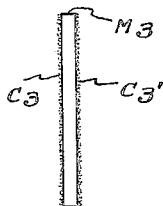


FIG. 4.

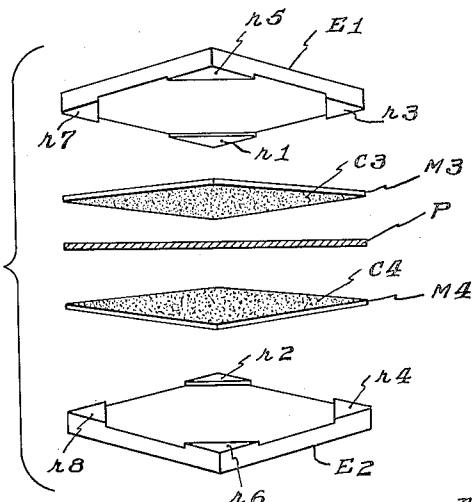


FIG. 5.

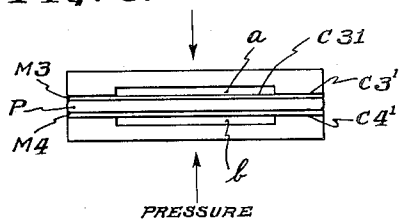


FIG. 6.

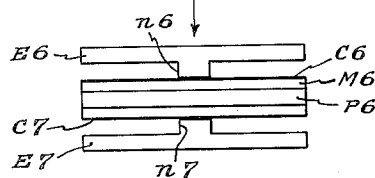
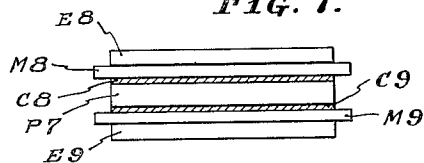


FIG. 7.



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MOUNTING FOR PIEZOELECTRIC
ELEMENTS

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Application December 31, 1935, Serial No. 57,000

11 Claims. (Cl. 171—327)

This invention relates to the piezo-electric art, particularly to the mounting of quartz or other piezo-electric crystals and has for its principal object to provide improvements in mountings of the general type disclosed in copending application Serial No. 52,304 to Samuel A. Bokovoy and Paul D. Gerber, filed November 30, 1935.

Our above identified application discloses a mounting arrangement for piezo-electric crystals wherein the crystal is mounted between a pair of electrodes with one or more interposed layers of insulating material. The insulating material employed has a dielectric constant higher than that of air and preferably higher than that of the crystal substance. As more fully explained in the patent specification, such mode of mounting permits of the crystal being vibrated close to its elastic limit without danger of corona discharge or arcing which, if present, would tend to puncture or otherwise damage the crystal and the electrodes associated therewith.

Our present invention contemplates and its practice provides a similar assembly of electrode plates, insulating layers and crystal but with the addition of a layer, coating or film of conducting material adjacent the interposed dielectric. Preferably, the conducting substance is plated, painted or sprayed directly on one or both major surfaces of the insulating inserts; it may, however, be constituted by one or more separate conducting strips.

The addition of the conducting material is especially advantageous where nodal mounting or pressure-air-gap type electrode plates are employed since it is then not necessary to fill the recesses in the plates with the dielectric (as taught by the earlier disclosure) to eliminate any possibility of arcing or corona effects. Regardless of the type of electrodes employed the conducting layer when adjacent the crystal may be thin enough and flexible enough to follow closely the contour of the crystal surface whereby the advantages of metal-plated piezo-electric crystals are achieved without the disadvantages of permanent plating.

Other objects and advantages 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 perspective view of a strip of mica plated on one side with a conductive coating;

Fig. 2 is a similar view of a strip of mica completely enveloped by the conductive coating;

Fig. 3 is an end view of the coated strip of Fig. 2 with the edges trimmed to provide two separate conductive layers with an interposed dielectric layer;

Fig. 4 is an exploded view of a crystal mounting embodying the invention;

Fig. 5 is a side elevation of the assembly of Fig. 4 with the crystal retaining members in place;

Fig. 6 is a side elevation of a "nodal-zone mounting" embodying the invention; and

Fig. 7 is a side elevation of a "gravity-type holder" showing separate conductive and dielectric layers.

In carrying the invention into effect we may plate, paint or spray a dielectric material M, such as mica, with a conductive substance C, such, for instance, as colloidal graphite (or other carbonaceous substance), copper, nickel, silver, gold, platinum, or alloys thereof.

The conductive layer may be applied to but one surface of the insulating material, as in Fig. 1, or it may embrace the entire outer surface and edges of the insulating material, as shown by C2, in Fig. 2. If desired, the edges of the strip may be cut away, as in Fig. 3, to provide two conducting layers C3, C3' separated by the dielectric M3.

Figs. 4 and 5 show one manner of applying the invention to a conventional "air-gap pressure mounting" wherein the electrodes E1 and E2 are provided, respectively, with risers r1, r3, r5, r7; r2, r4, r6, r8. In this embodiment of the invention mica strips M3—M4, each similar to that shown in Fig. 3, are placed one on each side of the crystal P; the conductive layers of each strip contacting, on one side, the crystal P and on the other side the electrode risers "r".

If these strips M are coated each on but a single side, as in Fig. 1, the conductive surface is preferably placed in contact with the electrode risers.

Referring to Fig. 5 which shows the electrodes E1 and E2, the plated strips M3 and M4, and

the crystal P, assembled, it will be apparent that when energized the radio frequency potential gradient in the electrode recesses *a* and *b* is zero so that there is no possibility of arcing or corona effects even when the crystal is operated close to its elastic limit. This is so because the conductive surfaces C3' and C4' span the entire area of the respective recesses and in effect provide a "short circuit" between the walls of each recess *a* and *b*.

The same desirable operating characteristic is produced when a strip completely enveloped by conductive material, as in Fig. 2, is employed. Such a strip will appear to be the equivalent of a solid metal strip but we have not found it practical to dispense entirely with the body of insulating material because a solid metallic strip, if rigid enough to span the recesses *a* and *b*, without sagging, will exert an appreciable damping effect upon the crystal.

As in the usual "air-gap pressure mounting", clamping pressure, symbolically indicated by the vertical arrows, may be applied to the assembly.

Fig. 6 shows the invention as applied to a nodal zone mounting. The electrodes E6 and E7 are each provided with one or more risers $\pi 6$, $\pi 7$, placed along an axis of symmetry corresponding to a nodal axis of the crystal P6. Here, as in the embodiment of Figs. 4 and 5, any of the strips of Figs. 1, 2 or 3 may be employed. As illustrated, the strips M6 and M7 are of the type shown in Fig. 1, i. e. they are each provided with but a single conductive surface C6, C7, disposed respectively in contact with the electrode risers $\pi 6$ and $\pi 7$.

When assembled, as shown, with the plated mica strips M6—M7 disposed intermediate the electrodes E6—E7 and crystal P6 this mounting ensures maximum rigidity with minimum damping effect due to clamping and provides substantially complete freedom from arcing.

The invention is not necessarily limited to so called "air-gap" mounting arrangements nor indeed to applications requiring insulating strips coated with conductive material.

Fig. 7 shows the invention as applied to a "gravity-type" holder. The conductive surfaces are in the form of separate strips of metal foil C8—C9 placed on opposite sides of the crystal P7 and separated from the flat surfaced electrodes E8 and E9 by a pair of insulating strips M8 and M9. These strips of metal foil C8 and C9 should ordinarily be of a thickness substantially no greater than .001 of an inch.

While mica has been mentioned as the preferred insulating substance other materials such, for example, as rubber sheeting, "Cellophane", "bakelite" and vitreous enamels may be employed. Preferably the insulating material is in the form of separate sheets of, say .001—.005 of an inch thickness. As taught by the earlier copending application it may, however, be intimately joined to the electrode surfaces.

As a number of possible embodiments may be made of the above invention and as changes may be made in the embodiments described without departing from the spirit or scope of the invention it is to be understood that the foregoing is to be interpreted as illustrative and not in a limiting sense except as required by the spirit of the appended claims and by the prior art.

We claim:—

1. The combination with a piezo-electric element and a pair of electrodes therefor of a layer of insulating material and a layer of conductive material interposed between each electrode and said piezo-electric element.

2. The invention as set forth in claim 1 wherein a layer of conducting material is interposed between each layer of insulating material and said crystal.

3. The invention as set forth in claim 1 wherein a layer of conducting material is interposed between each layer of insulating material and each electrode.

4. The invention as set forth in claim 1 wherein a layer of conducting material is provided on each side of each layer of insulating material.

5. The combination with a piezo-electric element and a pair of electrodes therefor, of a pair of strips of insulating material interposed, respectively, between said electrodes and said crystal, said strips each having a coating of electrically conductive material intimately bonded thereto.

6. The invention as set forth in claim 5 wherein said coating of electrically conductive material is present only on that side of each insulating strip which is adjacent said electrodes.

7. The invention as set forth in claim 5 wherein said coating of electrically conductive material is constituted by a film of carbonaceous material.

8. The invention as set forth in claim 5 wherein said coating of electrically conductive material is constituted essentially by a film of metal.

9. The combination with a piezo-electric crystal and a pair of electrodes having projecting supporting surfaces thereon of a pair of strips of insulating material coated with a conductive substance, said strips disposed respectively on opposite sides of said crystal with their conductive coatings contacting the projecting supporting surfaces of said electrodes.

10. The invention as set forth in claim 9 wherein said electrodes are substantially rectangular in shape and said projecting supporting surfaces are disposed respectively adjacent each corner thereof.

11. The invention as set forth in claim 9 wherein said projecting supporting surfaces fall along a nodal axis of said piezo-electric crystal.

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