Sept. 14, 1943. E. M. WASHBURN 2,329,497

ART OF MOUNTING PIEZOELECTRIC CRYSTALS

Filed April 1, 1942

Fig. 1.

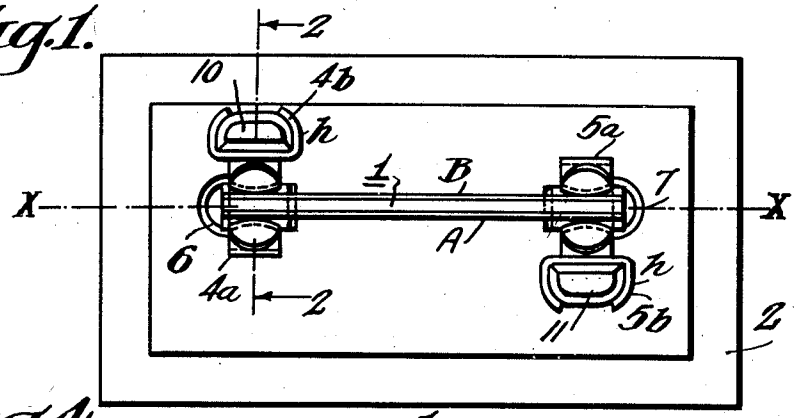


Fig. 4.

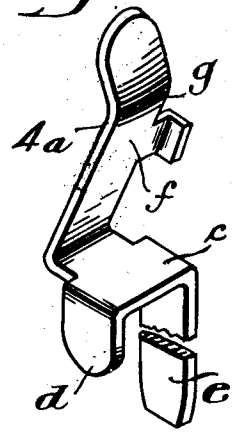


Fig. 2.

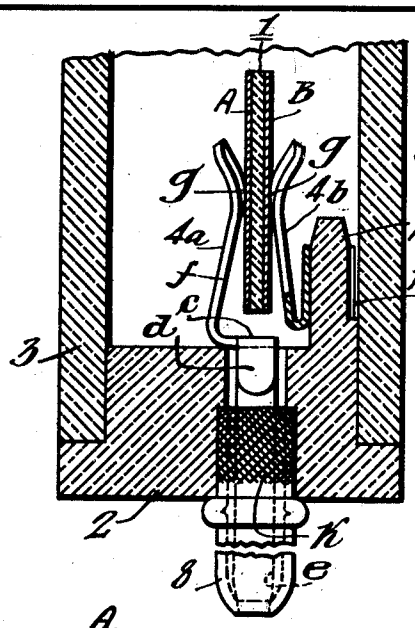


Fig. 5.

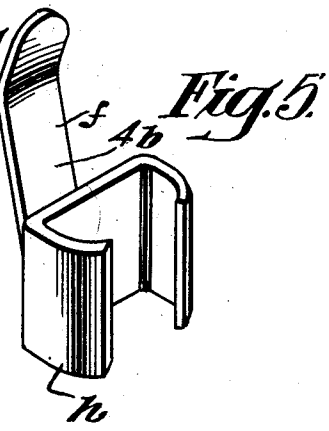
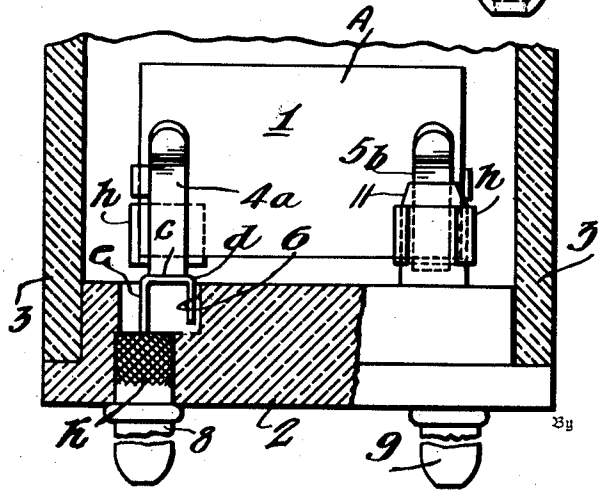


Fig. 3.



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Patented Sept. 14, 1943 2,329,497

UNITED STATES PATENT OFFICE

2,329,497

ART OF MOUNTING PIEZOELECTRIC CRYSTALS

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Application April 1, 1942, Serial No. 437,151

4 Claims. (Cl. 171—327)

This invention relates to the art of mounting piezo-electric crystals and has special reference to improvements in the mounting of crystals having metalized electrode faces.

In order to avoid a short circuit between the film-like electrodes of a plated piezo-electric crystal, it has previously been proposed (see Hawk U. S. Patent 2,228,601) to provide diagonally opposite uncovered or unplated end zones on the electrode faces of the crystal and to apply the necessary clamping or other mounting force to the crystal by means of a pair of clamps each having jaws which engage one covered and one uncovered end zone.

In order to provide the crystal with its unplated or uncovered end zones, it is necessary either (*a*) to mask the said surface areas during the plating operation or (*b*) to erase or dissolve a portion of a previously applied coating. Masking may be employed when the electrode metal is applied to the crystal by thermal evaporation, in vacuo. This method of metalizing a crystal has not received wide favor because it is expensive in that to achieve a good bond the crystal must be etched prior to the plating operation.

When the plating is first applied all over the crystal, as by an inexpensive precipitation method, it is a very simple matter to remove the metal from the side or minor faces of the crystal with a buffing wheel or the like. However, the use of a buffing wheel on the major or electrode faces would tend to alter the natural frequency of the crystal. Hence, the removal of the metal from the end zones of the major or electrode faces of the crystal becomes a tedious, time-consuming and somewhat dangerous operation in that it involves dissolving the metal by the use of nitric acid applied with a small orangewood stick or the like.

Accordingly, the principal object of the present invention is to provide an improved clamp-type mount for plated crystals and one which obviates the necessity for unplated or uncovered clamping areas on the electrode faces of the crystal.

Another object of the present invention is to provide a simple and compact plated crystal assembly which is nevertheless immune to short circuits, and which lends itself readily to mass production methods both in the plating and assembling operations.

Other objects and advantages, together with certain preferred details of construction, will be apparent and the invention itself will be best understood by reference to the following specification and to the accompanying drawing wherein

Figure 1 is a top plan view of a clamped crystal assembly incorporating the invention,

Figure 2 is a sectional view taken on the line 2—2 of Fig. 1,

Figure 3 is a side elevational view, on a reduced scale, of the crystal assembly,

Figure 4 is an enlarged view in perspective of a preferred form of conductive clamping member for the holder, and

Figure 5 is a similar view of one of the insulating clamping members shown in Figs. 1 to 2 inclusive.

In the drawing, wherein like reference characters designate the same parts in all figures, 1 designates a rectangular element or plate constituted of quartz or other crystalline substance having piezoelectric properties and which is provided with adherent metal electrodes A and B, respectively, which extend from edge to edge on its opposite major surfaces. These separate electrodes A and B may be formed by immersing the crystal 1 in a silver solution, precipitating the silver and thereafter removing the precipitated metal from only the minor surfaces of the crystal as by means of a buffing operation. The crystal 1 is supported, in accordance with the invention, above the insulated base 2 of a container 3 (see Fig. 3) by two pairs of spring metal elements 4*a*, 4*b*—5*a*, 5*b*, which exert their opposed mechanical forces upon the metalized faces A and B at opposite ends of the crystal and are arranged, in a manner later described, to prevent short circuiting between the said metalized crystal faces.

The base 2 of the container 3 may be constituted of "Bakelite" or other thermosetting or thermoplastic material. Two aperatures 6 and 7 (Fig. 1) which are spaced apart on the long axis, *x*—*x*, of the base 2 serve as separate seats for two dependent metallic socket prongs 8 and 9, respectively, through which electrical connections are made to the interior of the casing. These prongs are preferably hollow and may be provided with a knurled outer surface area K (Fig. 2) for frictional engagement with the walls of the apertures 6 and 7 in which they are seated. One of these hollow prongs, say prong 8, serves as a conductive support for the clamping element 4*a* of the first pair (4*a* and 4*b*) and the other prong 9 serves as a conductive support for the clamping element 5*a* of the second pair (5*a* and 5*b*). Referring particularly to Figs. 2 and 4, it will be seen that each of the clamping elements 4*a* and 5*a* comprises a flat base portion *c*, pair of dependent arms *d* and *e*, one of which (say arm *e*) has a snug fit within the bore of the

prong in which it is seated, and the other arm (*d*) of which fits in a recess adjacent the prong aperture (6 or 7), and an upstanding spring metal arm *f* which is bent inwardly and then outwardly adjacent its free end to provide an intermediate surface area *g* which bears against a metalized face of the crystal. As shown more clearly in Fig. 1, these clamping elements 4*a* and 5*a* face inwardly (in the direction of the axis *x*—*x*) and bear against diametrically opposite points on the separate metalized faces A and B, respectively, of the crystal 1.

These forces applied to the metalized faces A and B of the crystal by the spring metal elements 4*a* and 5*a* are opposed by forces of substantially equal intensity applied to the crystal through its opposite metalized surfaces by the spring metal arms 4*b* and 5*b*. These latter metal arms 4*b* and 5*b* may be of duplicate construction and have contact arms *f* similar to the ones (4*a* and 5*a*) with which they are paired. However, to prevent a short circuit between the opposite metalized faces A and B of the crystal the said arms 4*b* and 5*b* are insulated from the conductive connectors 4*a* and 5*a* by insulating supporting posts 10 and 11, which are provided for the purpose on the base 2 at diametrically opposite ends of the crystal 1. As shown more clearly in Fig. 1, the supporting posts 10 and 11 are non-circular, or D-shape in cross section and, referring also to Figs. 5 and 2, the spring metal arms 4*b* and 5*b* are affixed thereto by a similar shaped collars *h* with which each of the said arms is provided.

From the foregoing, it will be apparent that the present invention provides a simple and compact plated crystal assembly which is immune to short-circuiting and one which nevertheless lends itself readily to mass production methods both in the plating and assembling operations.

What is claimed is:

1. A holder for a piezoelectric crystal having a pair of oppositely located metalized electrode faces, a conductive clamping element mounted adjacent opposite ends of said crystal and biased to engage a different metalized electrode face, and insulated means mounted on opposite sides of said crystal substantially in register with said conductive clamping elements for exerting a counter biasing force upon said crystal.

2. A holder for a piezoelectric crystal having a pair of oppositely located metalized electrode faces, said holder comprising a plurality of pairs of spring metal clamping elements arranged to contact said metalized electrode faces of said crystal adjacent opposite ends thereof, and means for insulating the diagonally opposite of said spring metal elements from the spring metal elements with which they are paired.

3. In combination, a rectangular piezoelectric crystal having oppositely located metalized electric faces, and means for applying a clamping force to said crystal at a plurality of opposed areas on its said oppositely located metalized faces, said clamping means comprising a pair of spring metal elements mounted adjacent to one end of said crystal and another pair of spring metal elements mounted adjacent to the opposite end of said crystal, said crystal being received at each end between said pairs of spring metal elements, and means for insulating one spring metal element of each pair from the second spring metal element of the same pair, the second spring metal element of one of said pairs being arranged to contact one of said metalized electrode faces and the second spring metal element of the other pair being arranged to contact the other of said metalized electrode faces.

4. A holder for a crystal having oppositely located metalized electrode faces, said holder comprising a base having a central axis, an insulating post on said base at one side of said axis adjacent to one end of said crystal, a second insulating post on the other side of said axis adjacent to the other end of said crystal, a clamping element supported on each of said insulating posts and biased to engage the metalized face which is adjacent thereto, a complementary spring metal clamping element mounted on each of said opposite sides of said axis in register, respectively, with said first mentioned clamping elements and each biased to engage the metalized electrode face which is adjacent thereto, and means for connecting said last mentioned clamping elements to an external circuit.

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