Aug. 17, 1943. S. A. BOKOVOY 2,326,923

ART OF MOUNTING PIEZOELECTRIC CRYSTALS

Filed Sept. 30, 1941

FIG. 1.

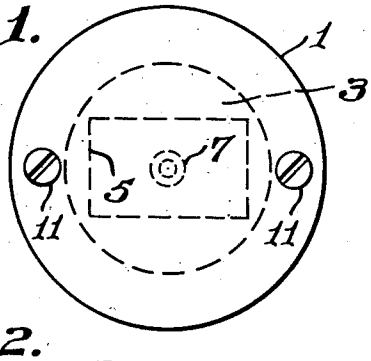


FIG. 3.

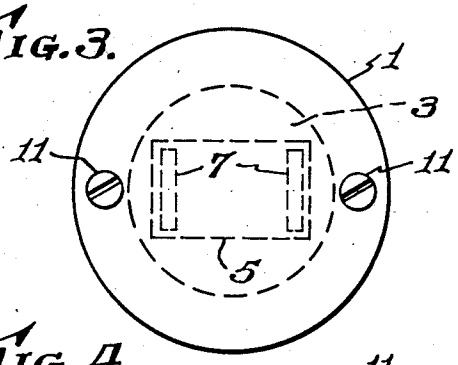


FIG. 2.

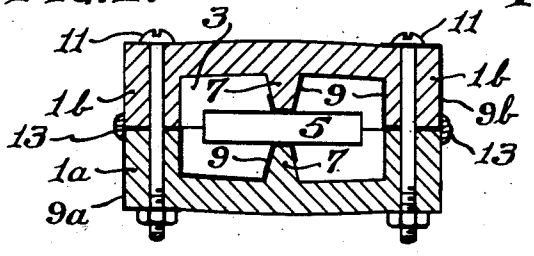


FIG. 4.

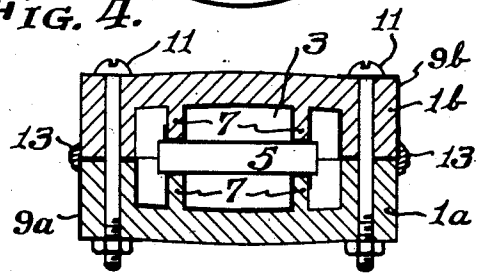


FIG. 5.

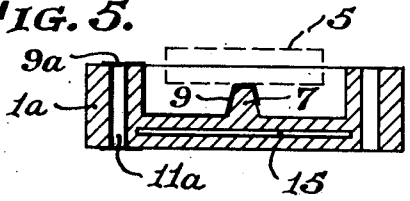


FIG. 6.

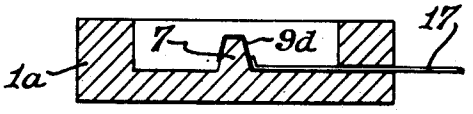


FIG. 7.

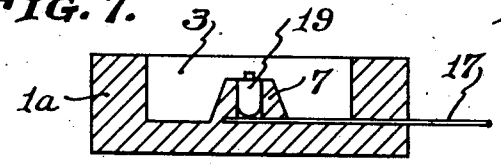


FIG. 8.

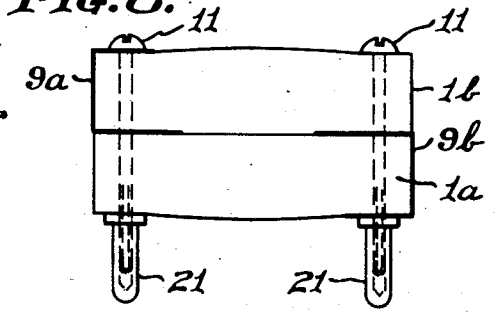
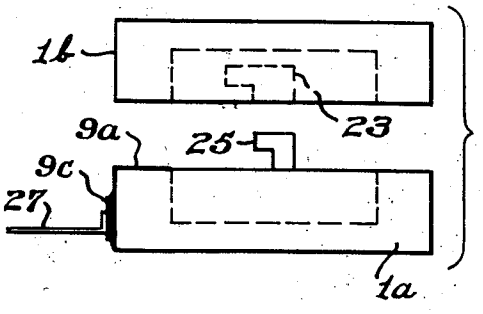


FIG. 9.



Inventor

Samuel A. Bokovoy

By J. J. Huff

Attorney

Patented Aug. 17, 1943

2,326,923

UNITED STATES PATENT OFFICE

2,326,923

ART OF MOUNTING PIEZOELECTRIC CRYSTALS

Samuel A. Bokovoy, Audubon, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application September 30, 1941, Serial No. 413,056

8 Claims. (Cl. 171—327)

This invention relates to the art of mounting piezoelectric crystal elements.

The principal object of the present invention is to provide an improved hermetically sealed holder for a piezoelectric crystal and one which dispenses with the use of expansible clamps and/or separable electrodes and other parts which heretofore have usually been formed of "strategic" (i. e., war-scarce) metals.

Another and related object of the present invention is to provide a simple, inexpensive, compact and trouble-free, hermetically sealed, clamped-crystal holder and one which lends itself readily to mass production methods of construction and assembly.

The foregoing and other objects are achieved in accordance with the present invention by the provision within a bipart, molded flexible-plastic casing of two or more metal-covered risers or "pins" which form an integral part of the separable casing sections and which are so dimensioned, positioned and arranged as to constitute the sole necessary supporting means for a metal-coated quartz or equivalent piezoelectric element. The necessary two external connectors for the crystal preferably, though not necessarily, comprise adherent ribbon-like metal coatings which extend in opposite directions from the crystal supporting risers along and between the facing surfaces of the separable casing sections.

Certain details of construction, together with other objects and advantages, 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 hermetically sealed, flexible holder constructed in accordance with the invention and containing a node-mounted crystal,

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

Figure 3 is a top plan view of another hermetically sealed, flexible holder within the invention and containing a thickness mode crystal clamped adjacent its opposite ends,

Figure 4 is a sectional view taken on the line 4—4 of Figure 2,

Figure 5 is a sectional view of a reinforced holder part embodying the invention,

Figure 6 is a similar view showing a part of the holder and an alternative form of lead therefor,

Figure 7 is a sectional view of a flexible casing part containing a pivot upon which a crystal may be mounted,

Figure 8 is a side elevational view, partly in section, showing a holder within the invention and provided with prong-type connectors, and

Figure 9 is an exploded side elevational view, partly in section, showing an alternate form of clamping means for the separable parts of the holder casing.

In the drawing wherein like reference characters designate the same or corresponding parts in all figures, 1 designates a circular or other shape casing having a central cavity 3 within which a metal-plated quartz or other piezoelectric crystal element 5 is adapted to be accommodated. The casing 1 is preferably of bipart construction and in the embodiments of the invention here illustrated comprises "bottom" and "top" halves 1*a* and 1*b*, respectively, of duplicate shape and construction. These two casing sections may be formed of "Bakelite" or of "styrol" or other thermosetting or thermoplastic resin, or they may comprise glass or other moldable material capable of being flexed or bowed to the required degree. In accordance with the invention, the inner surface of each of the casing sections 1*a* and 1*b* is provided with one (see Figs. 1 and 2) or more (see Figs. 3 and 4) integral risers 7, which are provided on their facing surfaces with adherent film-like conductive coatings 9 between which the crystal element 7 is adapted to be accommodated upon the application of a clamping force to the assembled casing sections as by screws 11 arranged adjacent the periphery thereof. These integral supports 7 may be centrally disposed (as shown in Figs. 1 and 2) when the crystal to be mounted therebetween has a central nodal point or they may be located in register with the marginal edges of the crystal, as shown in Figs. 3 and 4, in the event that its area of minimum oscillatory movement lies adjacent its end zones. In either event, the rise of these aligned supports 7 is preferably such that the spacing therebetween, when one casing section is laid without clamping force upon the other section, is slightly less than the thickness dimension of the crystal to be mounted therebetween. By way of example, in one successful embodiment of the invention, the spacing between the oppositely located risers 7—7 (Fig. 2) was substantially twenty mils of an inch when the overall thickness dimension of the crystal 5, adjacent its center, was substantially twenty-five mils of an inch. As indicated by the convex appearance of the top and bottom surfaces of the as-

sembled casings of Figs. 1–4, sufficient force was applied to the crystal through its supports 7, by means of the screws 11, to produce a substantial flexing of the casing material.

It will be observed upon inspection of Figs. 3 and 4 that the metallized facing surfaces 9 of the risers 7 extend in the form of separate adherent ribbons 9a and 9b in opposite directions along the inner and between the rim surfaces of the casing sections 1a and 1b and is continued on the outer surfaces of the said parts to the metal screws 11. The casing sections 1a and 1b are preferably cemented together to provide a hermetic seal, as indicated at 13, Fig. 2. Thus, the screws 11 may be used as binding posts for the necessary circuit leads (not shown) without disturbing the clamping force exerted upon the crystal. Alternatively, as shown at 9c, Fig. 9, the conductive coating on the exterior of the casing may be built up to a thickness sufficient to permit a lead wire 9d to be soldered thereto.

Referring to Fig. 5: The casing may be reinforced if desired by means of a flat spring 15 molded in the casing material. This spring 15 is of especial utility when the casing is subjected to temperatures approaching the softening point of the casing material and serves to maintain the clamping force upon the crystal in spite of a temporary reduction in the flexibility of the said material. Spring 15 may be of bimetallic construction and so oriented that it exerts a temperature-controlled counter biasing force upon the crystal 5, through its support 7, upon expansion of the casing due to heat. Attention is also called to the fact that, in the holder shown in Fig. 5, the thin metallic coating 9a which comprises the conductive lead for the crystal extends into the screw hole 11a instead of over the outer side walls of the casing.

Referring to Fig. 6: While, as previously indicated, the leads from the risers 7 upon which the crystal is supported preferably comprise conductive coatings applied directly to the surface of the casing, they may each be in the form of a solid metal cap 9d which is provided with a soldered wire connector 17 which extends through the casing material to the exterior of the device.

In the holder shown in Fig. 7, the riser 7 which, as in the other illustrated embodiment of the invention, is integral with the casing, is provided with a central bore within which a rotatable bearing 19 is seated. The clamping force incident to the assembly of the separate casing sections is applied to the metalized face of the crystal (not shown) through the said bearing. Thus, as claimed in copending application Serial No. 400,068, to Bokovoy et al., filed June 27, 1941, any normal operating force tending to cause relative movement between the metallized faces of the crystal and its support is translated into rotary movement of the entire assembly whereby friction tending to wear away the metallized faces is obviated. In this case the electrode leads are in the form of separate wires or strips 17 which extend through the base of the risers 7 into the bore thereof.

Referring to Fig. 8: If desired, the casing 1 may be provided with a pair of prongs 21 for connection to the terminals of a socket type base, not shown. In this case the clamping screws 11 terminate within the prongs and connections made to the interior of the casing through metallic coatings 9a, 9b arranged in a manner similar to those described in connection with Figs. 2 and 5.

Referring to Fig. 9: The separate flexible casing sections 1a and 1b may be provided with a so-called bayonet type lock, comprising male and female elements 23 and 25 arranged in register with each other on the facing peripheral surface of said sections, instead of the metal screws or bolts 11 of Figs. 1–5 and 8. In this case a simple twisting movement of the sections 1a—1b serves to lock and unlock the casing. As previously set forth, the metallic coating 9a, 9b which extends into the cavity of the casing may be built up, as indicated at 9c, to a thickness sufficient to permit a circuit lead 27 to be soldered thereto.

Numerous other modifications and embodiments of the invention will suggest themselves to those skilled in the art. It is to be understood therefore that 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. In combination, a holder for a piezoelectric crystal comprising a pair of cup shape members constituted of a flexible insulating material and adapted to form a hollow casing when their peripheral surfaces are brought into contacting relation, each of said flexible casing sections being provided with an inwardly directed oppositely located crystal supporting riser on an inner surface thereof, a piezoelectric crystal between said risers, the rise of said risers being such that the space between their facing surfaces is normally less than the thickness dimension of said crystal, and means for bringing the said peripheral surfaces of said flexible casing members together when said crystal is in position between said risers.

2. The invention as set forth in claim 1 and wherein said flexible casing members are constituted of a synthetic resinous material.

3. The invention as set forth in claim 1 and wherein said flexible casing members are constituted of glass.

4. The invention as set forth in claim 1 and wherein said risers are provided with metallized facing surfaces and wherein separate adherent metal coatings extend from said metallized surfaces to the exterior of said casing.

5. The invention as set forth in claim 1 and wherein said crystal supporting risers are integral with said casing members.

6. The invention as set forth in claim 1 and wherein said oppositely located risers are arranged adjacent the center of said casing and comprise a nodal support for said crystal.

7. The invention as set forth in claim 1 and wherein a plurality of risers are provided on each casing member, said risers being in register with opposite end zones of said crystal.

8. The invention as set forth in claim 1 and wherein the peripheral surfaces of said casing members are provided with complementary closure elements.

SAMUEL A. BOKOVOY.