July 1, 1941. J. B. ATWOOD ET AL 2,247,627

PIEZOELECTRIC CRYSTAL HOLDER

Filed March 9, 1938

Fig. 1

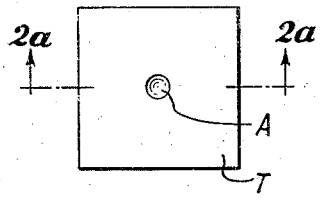


Fig. 3

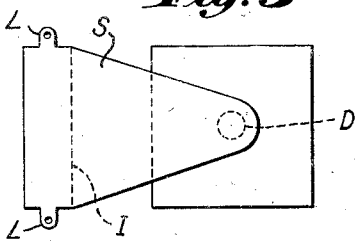


Fig. 2a

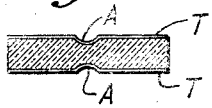


Fig. 3a

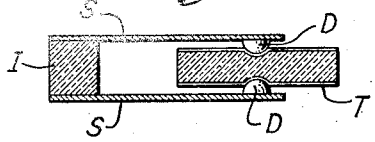


Fig. 2b

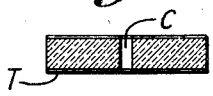


Fig. 3b

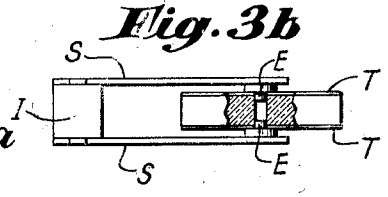


Fig. 4

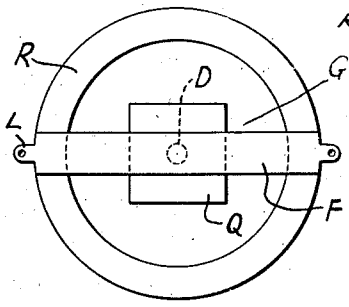


Fig. 4a

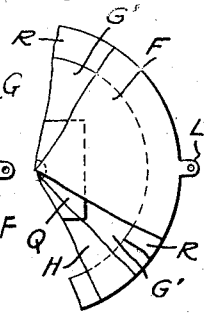


Fig. 6

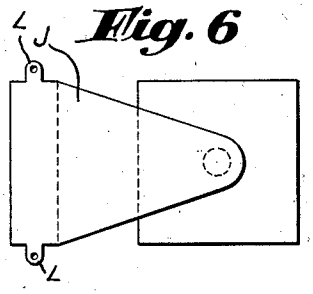


Fig. 5

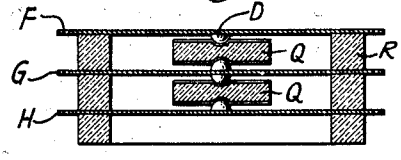


Fig. 5a

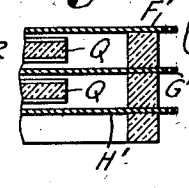


Fig. 7

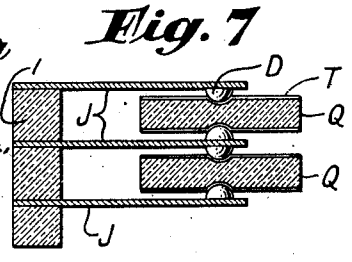
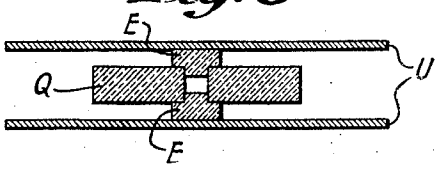


Fig. 8



INVENTORS
J. B. ATWOOD AND
DEWITT RUGG GODDARD

BY

ATTORNEY.

Patented July 1, 1941

2,247,627

UNITED STATES PATENT OFFICE

2,247,627

PIEZOELECTRIC CRYSTAL HOLDER

John Boyd Atwood and De Witt Rugg Goddard, Riverhead, N. Y., assignors to Radio Corporation of America, a corporation of Delaware

Application March 9, 1938, Serial No. 194,790

9 Claims. (Cl. 171—327)

This invention relates to an improved form of piezo-electric crystal holder and particularly to methods of supporting the crystal.

An object of this invention is to simplify and improve piezo-electric quartz crystal holders, particularly those used for low frequency circuits.

A feature of this invention is the means by which a crystal is retained by a slight depression located at the nodal point therein.

Certain types of quartz crystals used mainly for low frequencies have a mode of vibration with a nodal point in the center of the large faces. When these are used for filter purposes, the problem arises as to how to mount them. An air gap holder would be unsuitable, as a change in the air gap would produce a change in the filter characteristics. The best way to eliminate the air gap is to plate the electrodes on the crystal surfaces. The crystal must then be supported at the nodal point. In the past, this support has consisted of a holder with two small pins opposite each other and making connection with the plating by pressure at the nodal point. This is undesirable, since the crystal characteristics are changed if the pins should not be centered correctly on the crystal nodal point. There is also the disadvantage that the crystal may shift its location due to jars, perhaps received during shipment. This would change the crystal characteristics and there is the possibility of destroying the plating beneath the supporting pins.

Our invention overcomes the above-mentioned difficulties, as will be seen by referring to the accompanying drawing, in which:

Fig. 1 is a plan view of a piezo-electric crystal which is intended to be supported at its nodal point;

Fig. 2*a* is a sectional view of Fig. 1, the section being taken on line 2*a*—2*a*;

Fig. 2*b* is a section similar to that of Fig. 2*a*, except for the mounting means;

Fig. 3 is a plan view of a piezo-electric crystal holder;

Fig. 3*a* is a sectional view of Fig. 3, showing the mounting springs for retaining a crystal shown in Fig. 2*a*;

Fig. 3*b* is another embodiment of the mounting springs for retaining a crystal, shown in Fig. 2*b*;

Fig. 4 is a plan view of a circular type of crystal holder;

Fig. 4*a* is a partial plan view of a holder similar to that of Fig. 4, except that the springs are disc-shaped;

Fig. 5 is a cross-section of Fig. 4;

Fig. 5*a* is a cross-section of Fig. 4*a*;

Fig. 6 is a plan view of a still further embodiment of this invention; and

Fig. 7 is a section of Fig. 6; and

Fig. 8 is a section of a crystal holder having an air gap.

Referring now in detail to the figures of the drawing, it will be seen that the holder is constructed of springs S supported on a block of insulating material I. Mounted on springs S is a pair of supporting pins for the quartz crystal. These pins may be in the form of small balls D, as shown in Fig. 3*a*, or a pair of pins E, shown in Fig. 3*b*, which are provided with two shoulders of different diameters. When the small balls D are used, the quartz crystal is ground out at the nodal point to fit the small balls, as shown in the depressed portions A of Fig. 2*a*, or A in Fig. 1. However, if the small stepped or shouldered pins E are used, a small hole C is drilled through the crystal at the nodal point and is of such a size as to admit only the small diameter of the pin E. The larger diameter of the pin then forms a supporting shoulder, the smaller diameter being employed to prevent the crystal from shifting its location. The crystals as shown in Fig. 1 are ground or drilled as desired, and then to improve their electrical characteristics are plated with a conducting material, such as for example, gold, to provide suitable electrodes T for the crystal. The balls D or pins E then provide connection from the electrodes, as well as a support from which the quartz cannot move, due to jars or vibrations. The crystals may be readily removed and replaced, the construction being such that they must be returned to the same place. To insure a good electrical contact between the pins and electrodes, it is preferred that pins D and E also be gold plated, thus providing good electrical conductivity, as well as preventing oxidization. As is well known to those skilled in the art, the grinding or drilling of the quartz will change its characteristics slightly, but once ground, the characteristics of the crystal will not change.

Referring now to the embodiment shown by Figs. 4 and 5, an insulating ring R has mounted thereon three support springs F, G and H, each of which is equipped with either balls D or pins E, located in the center of each spring for retaining a crystal Q which is similar in shape to the crystal shown in Figs. 1 and 2*a*, or 2*b*. Although a strip type of spring is shown, in Fig. 4*a* and Fig. 5*a* it is illustrated that any or all of the springs F', G' and H' could be made in the form of a circular disc, particularly if spring G is made into

a disc and ring R divided in three parts and bound together by any suitable means (not shown), it will provide a shielding effect upon springs F and H, the central spring G may be employed as making a common connection between two quartz crystals Q, as clearly shown in Fig. 5. This type of holder is particularly useful in certain filter circuits which have a common connection for the two crystals.

A still further type of crystal holder is shown by Figs. 6 and 7, which consists of three springs J mounted upon an insulating block I with either balls or pins mounted near the ends of the crystal supports. Three springs are used for the same purpose as in the first type of holder. This second type of holder has the advantage that the crystals can be inserted in or moved from the holder somewhat more easily than in the one shown in Fig. 4. In all types of holders, springs may be made to provide soldering lugs L to make connections to the plated electrodes through the springs. These springs also provide protection against jars breaking the quartz as the size of the supporting pins must be small in relation to the area of the crystal.

Fig. 8 shows an additional embodiment of an air gap type of crystal holder which is particularly adapted to piezo-electric crystal oscillators, in which it is better to provide an air gap in place of the plating provided for use with filter circuits for the reason that when the crystals are used as oscillators there is a possibility of the plating wearing away. This, however, could be prevented to some extent by making the plating heavier under the balls D at the support point A in Fig. 2*a* or under the larger diameter of the pins E surrounding the aperture C in Fig. 2*b*. For an oscillator, it would be better to eliminate the plating entirely and use an air gap type of holder as in Fig. 8. This consists, as before, of the stepped pins E, the smaller diameter being used to locate the crystal properly at its nodal point. The larger diameter is used as a support and as a spacer to provide an air gap for the electrodes U. The electrodes U are of conducting material, whereas the pins E, in this case, are not necessarily conducting. The shape of the electrodes U and their mounting methods are not shown as these will vary depending on the design of the equipment with which they are used.

Although only a few modifications of this invention are shown, it is to be distinctly understood that it should not be limited to the precise showing therein.

What is claimed is:

1. A piezo-electric crystal holder comprising a crystal having an aperture located at its nodal point, said aperture extending from one surface to another and a plurality of spring members, a plurality of stepped pins secured to one end of said spring members, said pins having the stepped portion located on each face of said crystal and the small diameter portion of the pins extending through a portion of said aperture.

2. A piezo-electric crystal comprising a crystal having a concave depression located at the nodal point on both faces of said crystal, and a plated electrode formed on each face and concave depression of said crystal.

3. A piezo-electric crystal holder comprising a piezo-electric crystal, a ring of insulating material surrounding said crystal, a plurality of metallic disc-like spring members supported by said ring, each spring member having means for retaining said crystal at its nodal point.

4. A piezo-electric crystal holder comprising at least two piezo-electric crystals, an insulating ring, a plurality of spring members located on said ring, at least one of said spring members forming a common connection for two piezo-electric crystals, and means located on said springs for retaining said crystals at their nodal points.

5. A piezo-electric crystal comprising a crystal having a concave depression located at the nodal point on both faces of said crystal, and an electrode formed on each face of said crystal and concave depression by plating.

6. A piezo-electric crystal oscillator holder comprising a piezo-electric crystal having a central aperture, electrodes for said crystal, and insulating means located at said aperture to space said crystal from said electrodes.

7. A piezo-electric crystal oscillator holder comprising a piezo-electric crystal having a central aperture, electrodes for said crystal, and insulating pins located to extend in said aperture to space said crystal from said electrodes.

8. A piezo-electric crystal comprising a crystal having an aperture located at its nodal point, means for supporting said crystal at its nodal point, and a plated electrode formed on each apertured face of said crystal, the thickness of said plated electrodes being increased at the nodal point of said crystal.

9. A piezo-electric crystal holder comprising two piezo-electric crystals, a plurality of insulating rings surrounding said crystals, a plurality of spring members located on said rings, at least one of said spring members being in the form of a disc, said one spring member being interposed between said crystals to form a shield and common connection for the two piezo-electric crystals, and means located on said springs for retaining said crystals at their nodal points.

DE WITT RUGG GODDARD.
JOHN BOYD ATWOOD.