Sept. 20, 1949. L. LE R. DIMMICK 2,482,661

CRYSTAL MOUNTING

Filed Aug. 15, 1946

Fig. 1.

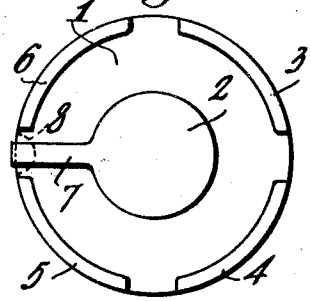


Fig. 2.

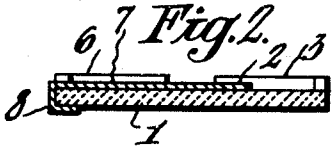


Fig. 3.

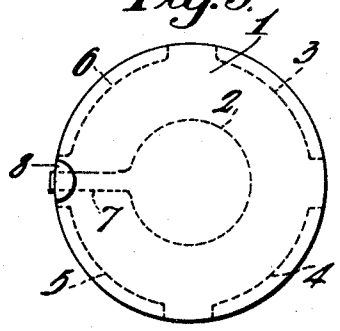


Fig. 4.

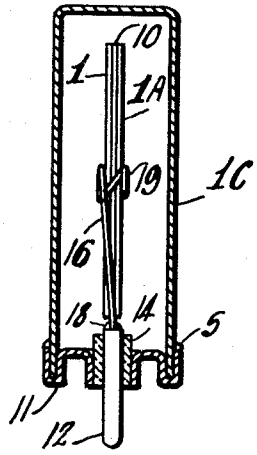


Fig. 5.

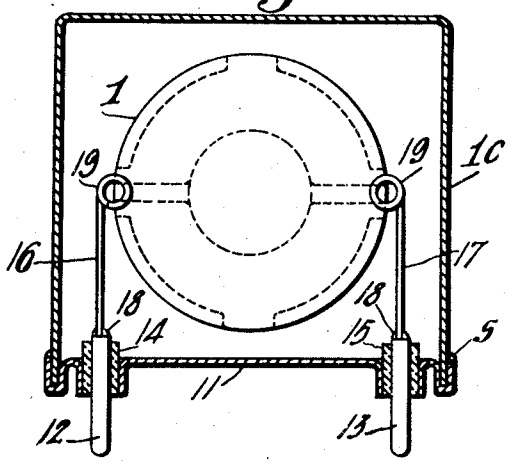


Fig. 6.

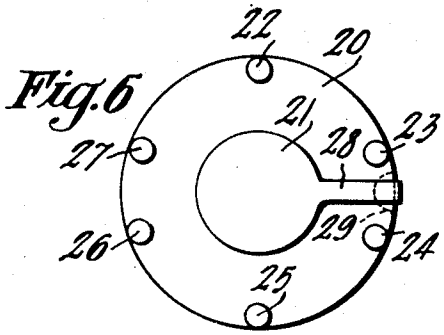


Fig. 7.

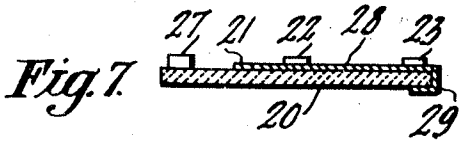


Fig. 8.

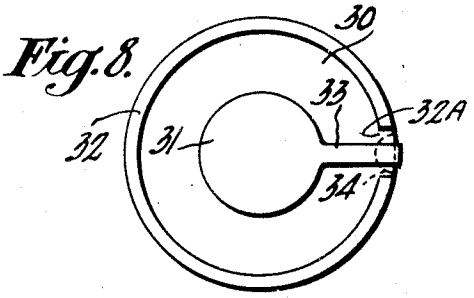
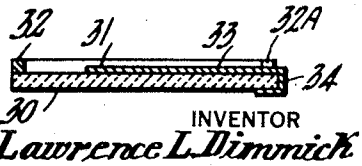


Fig. 9.



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CRYSTAL MOUNTING

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Application August 15, 1946, Serial No. 690,624

13 Claims. (Cl. 171—327)

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This invention relates to a new and useful piezoelectric crystal mounting, and more particularly to the type having non-conducting electrodes.

An object of this invention is to provide a rigid mounting with a flexible support for high frequency thickness, shear crystals in which the electrodes are made of quartz, or a non-conductor with approximately the same coefficient of expansion as quartz, and with metallic coatings on the front face of the electrodes with portions of this coating thicker than in the central area.

The electrodes forming the crystal holder of this invention are preferably made the same size as the oscillating crystal and lapped flat. A small terminal spot of metal is fired on the back face adjacent to the edge and covering a small area of the edge. A metallic coating is applied to the central area of the front face either by evaporation, by chemical deposit, or by a silk screen method. The metallic coating extends out to the edge to make contact with the fired metal terminal spot on the back face. Another metallic coating is applied on the front face adjacent to the edge either in a continuous band, in segments, or spots of any shape, and coated thicker than that of the coating on the central area to furnish a small airgap between the central area coating and the oscillating crystal. This edge coating does not make electrical contact with the central area.

The crystal holder assembly includes two of the above mentioned electrodes; a piezoelectric crystal is placed between the two electrodes with the front face next to the crystal. This crystal holder assembly is clamped to a base with coil spring terminal clips which are soldered to the contact pins of the holder. The spring terminal clips are secured to the fired metal spot on the electrodes with a conducting cement.

This invention will be more clearly understood by referring to the accompanying drawing, in which:

Fig. 1 is a front elevation of the electrode of this invention;

Fig. 2 is a cross-section of Fig. 1;

Fig. 3 is a rear elevation of Fig. 1;

Fig. 4 is an end elevation of the crystal holder of this invention;

Fig. 5 is a front elevation of Fig. 4;

Fig. 6 is a front elevation of another modification of the invention;

Fig. 7 is a cross-section of Fig. 6;

Fig. 8 is a front elevation of a still further modification of the invention; and

Fig. 9 is a cross-section of Fig. 8.

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Referring now in detail to Figs. 1, 2 and 3 of the drawing, the non-conducting disc electrode 1 is made of quartz, ceramic or similar materials having essentially the same coefficient of thermal expansion as the quartz plate or crystal element. In order that the disc 1 can act as a crystal holder electrode, it has located thereon a circular metallized portion 2 which is applied on the central area by either chemical deposition, evaporation, or by being fired on by a silk screen process. The peripheral edge of disc 1 has located thereon four metal segments 3, 4, 5 and 6. The segments 3, 4, 5 and 6 are also metallized in the same manner as the central area 2. However, the segments are coated thicker than that of the central area 2, and this area 2 serves as one of the crystal electrodes. The increased thickness of the segments furnishes an air-gap between the central area and the crystal element, and therefore does not make electrical contact therewith. The electrical contact between the central area 2 and each one of the terminals of the crystal holder is made by means of an outwardly extended strip or path 7 which is provided with a terminal edge area 8 indicated between the dotted line in Fig. 1 and the full line in Fig. 3.

The crystal holder mounting is shown by Figs. 4 and 5 wherein the crystal element 10 is supported between two electrode discs 1 and 1A. The crystal element 10 is very thin relative to its diameter. The two surfaces are ground slightly convex to insure that the crystal will oscillate, as I have found that on very thin crystals, if the surfaces are not parallel or slightly concave, the crystal element will not properly oscillate. A base 11 of metal (such as Kovar) is provided with two terminal studs 12 and 13 which extend through base 11. The terminal studs are insulated by a glass bead construction which includes glass terminal beads 14 and 15. The terminal studs, the base, and the glass beads, or any similar insulating material, must have approximately the same coefficient of thermal expansion in order that they will bond properly together to insure a hermetically sealed joint. If desired, the base 11 could be made of insulating material with terminal studs secured to the base by any suitable means, such as having molded integral therewith suitable terminal bushings or by the use of suitable threaded studs and locking nuts. The assembly comprising crystal element 10 and electrodes 1 and 1A is clamped with coil spring clips 16 and 17. The spring clips are soldered to the contact terminal pins 12 and 13 of the holder at a point 18. The upper portion of the spring clips are bent in the form of a circular loop 19

and are secured to the fired metallic spot 8 with any suitable conducting cement. The holder is inclosed by a casing member 1C which is secured to the base 11 by soldering at S, or by any other suitable means to hermetically seal the crystal therein.

Another modification of the non-conducting electrodes of this invention is shown by Figs. 6 and 7, wherein the non-conducting disc 20 has a metallic center coating 21 applied to the front face in a similar manner to that of coating 2 described above. A plurality of small circular spots 22 to 27, inclusive, are located symmetrically around the face of disc 20, adjacent to the edge. The spots 21, although shown circular, may be of any shape or configuration. The air-gap between the crystal can be obtained by a non-conducting coating in an area adjacent to the edge, or by having a raised portion which can be molded by using a ceramic or a similar non-conductive disc. The circular electrode portion 21 is provided with an outwardly extending strip or path 28 which extends over the edge of disc 20 and terminates in a semi-circular portion 29, as is indicated in Fig. 7.

Figs. 8 and 9 disclose a still further modification of this invention, wherein a molded ceramic disc 30 has located thereon a central metallic electrode area 31. The peripheral edge is provided with a circular path 32. The circular path 32 is not continuous and is provided with a spaced gap portion 32A. Between the gap portion 32A there is located a metallic conducting path 33 which extends over the pehipheral edge of disc 32 and carries over to the opposite face where it terminates in a semi-circular terminal portion 34. The crystal element of this modification is supported in a similar manner to that shown by Figs. 4 and 5, the terminal springs 16 and 17 being connected to the opposite semi-circular metallic portions 34. The peripheral edge portion 32 is of greater thickness than the central electrode portion 31, in order to provide a proper air-gap for the crystal. The complete crystal holder is inclosed within a casing similar to that indicated at 1C in Figs. 4 and 5.

What is claimed is:

1. A piezoelectric crystal device comprising a piezoelectric crystal, a crystal electrode made of a material with the same coefficient of expansion as said crystal located on each side of said crystal, each one of said crystal electrodes having substantially the same area as said crystal, said crystal electrodes having permanently affixed thereto a central metallic electrode portion on one of its faces and also a noncontinuous peripheral metallic band portion located on the same face as said central metallic electrode portion, said noncontinuous peripheral metallic band portion being thicker than said central metallic electrode portion to provide an air-gap between the faces of said crystal and said electrodes.

2. A crystal holder comprising a piezoelectric crystal, a ceramic electrode mounted on each side of said crystal, each one of said crystal electrodes having permanently affixed thereto a central metallic electrode portion located thereon, a non-continuous peripheral metallic band portion located on the same face as said central metallic portion of said electrode permanently affixed thereto, the noncontinuous peripheral edge being thicker than the central metallic band portion to provide an air-gap between the faces of the crystal and said electrodes.

3. A piezoelectric crystal device comprising a piezoelectric crystal, a non-conducting electrode located on each side of said crystal, each one of said crystal electrodes having a central metallic portion, a noncontinuous peripheral metallic band portion located on the same face as the said central metallic electrode portion, said noncontinuous peripheral metallic portion being thicker than that of said central electrode portion to provide an air-gap between the faces of the crystal and said electrodes, and a conductive metallic path extending out from the central metallic portion to the zone of the peripheral metallic band portion in such manner as to be insulated therefrom.

4. A crystal electrode holder comprising a piezoelectric crystal, a non-conducting electrode of insulation material having essentially the same coefficient of expansion as said crystal and being located on each side of said crystal, each one of said electrodes having a central metallic electrode portion on one of its faces and a noncontinuous peripheral metallic band portion located on its same face as said metallic band portion, said non-continuous peripheral metallic band portion being thicker than said central metallic portion to provide an air-gap between the faces of said crystal and said electrodes, and a conductive metallic path extending out from the central metallic portion to the zone of peripheral metallic portion in a manner to be insulated therefrom.

5. A piezoelectric crystal comprising a circular non-conducting disc, said circular non-conducting disc having a central metallic electrode portion on one of its faces, a noncontinuous peripheral metallic band portion located on the same face as said central metallic portion, the non-continuous peripheral metallic band portion being divided into spaced arcuate portions, the arcuate portions being thicker than the central metallic portion to provide an air-gap between the faces of the crystal and said electrode.

6. A piezoelectric crystal device comprising a piezoelectric crystal, a natural crystal electrode mounted on each side of said piezoelectric crystal, a central metallic electrode portion on one of the faces of said crystal electrode, a metallic portion comprising a plurality of circularly spaced arcuate segments located on the same face as said central metallic electrode portion, said segments being thicker than the said central metallic portion to provide an air-gap between the face of said crystal and said electrode.

7. A piezoelectric crystal device comprising a piezoelectric crystal, an artificially produced crystal electrode arranged to be mounted on each side of said piezoelectric crystal, a central metallic electrode portion on one of the faces of said crystal electrode, a metallic portion comprising a plurality of spaced arcuate segments located on the same face as said central metallic electrode portion, said segments being thicker than the said central metallic portion to provide an air-gap between the face of said crystal and said electrodes.

8. A piezoelectric crystal device comprising a piezoelectric crystal, a non-conducting electrode mounted on each side of said crystal, each one of said crystal electrodes having a central metallic portion, a noncontinuous peripheral metallic band portion including a plurality of metallic spots located on the same face as the said central metallic electrode portion, said metallic spots on said noncontinuous peripheral metallic band portion being thicker than said metallic central elec-

trode portion to provide an air-gap between the faces of the crystal and said electrodes.

9. A crystal electrode holder comprising a piezoelectric crystal, a pair of non-conducting electrodes of insulation material having essentially the same coefficient of expansion as said crystal, each one of said electrodes having a central metallic electrode portion on one of its faces and a noncontinuous peripheral metallic band portion located on the same face as said metallic portion, said noncontinuous peripheral metallic band portion being thicker than said central metallic electrode portion to provide an air-gap between the faces of said crystal and said electrodes, a base for said crystal holder, and a pair of spring terminal connection members insulatingly supporting said crystal and the pair of electrodes above said base.

10. A piezoelectric crystal device comprising a piezoelectric crystal, a crystal electrode made of a material with the same coefficient of expansion as said piezoelectric crystal located on each side of said piezoelectric crystal, each one of said crystal electrodes having substantially the same area as said piezoelectric crystal, a central metallic electrode portion permanently affixed to one of the faces of said crystal electrode and also a coating of metallic material arranged solely on the marginal area of one side of said crystal electrode and extending only over a portion but not the entire marginal area of the crystal, said coating of metallic material being thicker than the central metallic electrode portion to provide an air gap between the faces of said piezoelectric crystal and said crystal electrodes.

11. A piezoelectric device comprising a piezoelectric crystal, a crystal electrode made of a material with the same coefficient of expansion as said crystal located on each side of said crystal, each one of said crystal electrodes having substantially the same area as said crystal, said crystal electrodes having permanently affixed thereto a central metallic electrode portion on one of its faces and also spaced metallic portions arranged around the periphery of said crystal and permanently affixed to one surface thereof, said spaced metallic portions being thicker than said

central metallic electrode portion to provide an air gap between the faces of said crystal and said electrodes.

12. A piezoelectric device comprising a piezoelectric crystal, a crystal electrode made of a material with the same coefficient of expansion as said crystal located on each side of said crystal, each one of said crystal electrodes having substantially the same area as said crystal, said crystal electrodes having permanently affixed thereto a central metallic electrode coating on one of its faces and also a noncontinuous peripheral metallic band coating located on the same face as said central metallic electrode coating, said noncontinuous peripheral metallic band coating being thicker than said central metallic electrode coating to provide an air gap between the faces of said crystal and said electrodes.

13. Crystal holder comprising a piezoelectric crystal, a ceramic electrode mounted on each side of said crystal, each one of said crystal electrodes having permanently affixed thereto a central metallic electrode portion located thereon, an arcuate shaped incomplete metallic ring permanently affixed to said crystal and located on the same face as said central metallic portion of said electrode, the arcuate shaped incomplete metallic ring being thicker than the central metallic band portion to provide an air gap between the faces of the crystal and said electrodes.

LAWRENCE LE ROY DIMMICK.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,078,229	Bokovoy	Apr. 27, 1937
2,095,376	Bechmann	Oct. 12, 1937
2,229,172	Hawk	Jan. 21, 1941
2,392,429	Sykes	Jan. 8, 1946

FOREIGN PATENTS

Number	Country	Date
490,579	Germany	Jan. 9, 1930