March 31, 1942. H. O. PETERSON ET AL 2,278,093

CRYSTAL HOLDER

Filed Nov. 10, 1939

Fig. 1

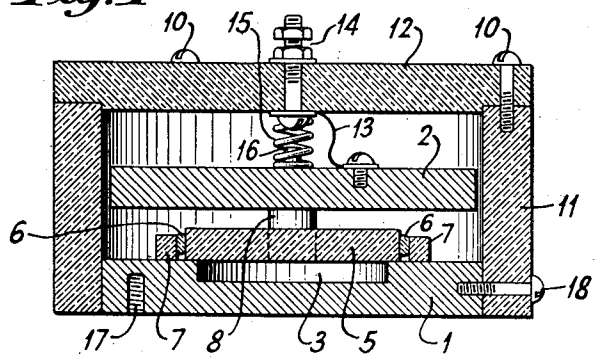
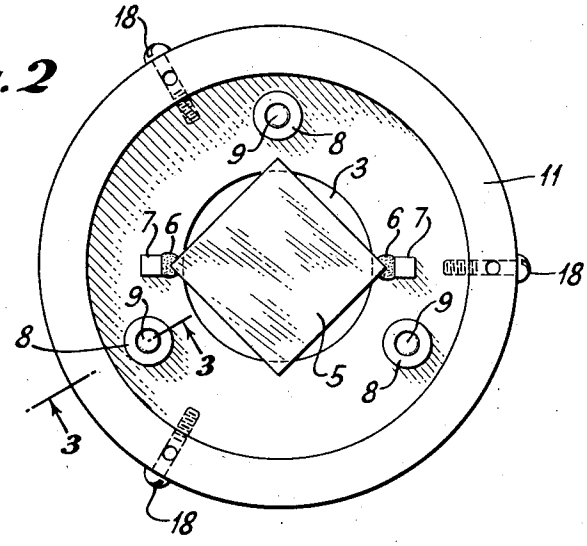



Fig. 2



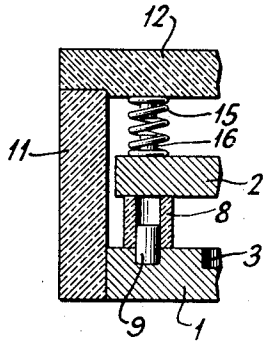




Fig. 3

BY

INVENTORS
HAROLD O. PETERSON
AND PAUL V. WINANS

ATTORNEY.

Patented Mar. 31, 1942

2,278,093

# UNITED STATES PATENT OFFICE

2,278,093

## CRYSTAL HOLDER

Harold O. Peterson and Paul V. Winans, Riverhead, N. Y., assignors to Radio Corporation of America, a corporation of Delaware

Application November 10, 1939, Serial No. 303,720

8 Claims. (Cl. 171—327)

This invention relates to a crystal holder suitable for use in a piezo-electric quartz controlled oscillator of very high stability.

An object of this invention is to simplify and improve crystal holders generally.

Another object of this invention is to provide an improved crystal holder in which the physical position of the crystal is accurately maintained with respect to the crystal electrodes.

Still another object of this invention is to provide air gaps on both sides of the crystal to minimize its damping.

A feature of this invention is the arrangement of the simple component parts to provide ease of assembly and general electrical efficiency.

One of the difficulties in obtaining extreme frequency stability in quartz crystal controlled oscillators is the change of frequency due to the mechanical or physical position of the crystal with respect to the electrodes. The novel crystal arrangement of this invention is such as will overcome these difficulties to a very large extent.

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

Fig. 1 is a cross-sectional view of the improved crystal holder of this invention;

Fig. 2 is a plan view of Fig. 1 with the cover and upper electrode removed; and

Fig. 3 is a fragmentary sectional view taken on line 3—3 of Fig. 2.

Referring now in detail to the drawing, the crystal holder comprises a circular metallic base electrode 1 and an upper electrode 2. Both electrodes are made of an alloy having a temperature coefficient of expansion very close to that of the piezo-electric crystal, such as for example Monel metal, which has been found satisfactory in a typical and practical application as its temperature coefficient is $13.7/10^6/C^0$ and quartz cut at right angles to its axis=$13.37/10^6/C^0$ and $7.97/10^6/C^0$ when cut parallel to its axis. Another metal which might be used as electrodes is that of nickel steel whose temperature coefficient is from 0.9 to $12/10^6/C^0$. The lower or base electrode has a depressed space or aperture 3 which is substantially equal in depth to the space between the upper electrode 2 and the crystal 5. The area of space 3 is equal to or substantially greater than the crystal surface but is of a different outline or shape, in order that a very small portion of the crystal will overlap in order that the crystal may slightly rest on the edge of electrode 1. For example, as is shown in Fig. 2 of the drawing, a rectilinear crystal is arranged over a circular aperture. The diameter of the aperture is greater than that of the width of the crystal but less than its diagonal, so that the extreme corners of the crystal are secured in a fixed location above aperture 3 by means of two small insulating blocks 7 which are fastened by any suitable means, such as for example by cement, to the lower electrode 1, and in turn connected to the crystal through a small quantity or drop of insulating cement. Block 7 is preferably made of hard rubber or "Bakelite" and the drop of cement 6 is preferably that of "Glyptol." The electrodes 1 and 2 are spaced by means of insulating pillars 8 which have a coefficient of expansion such as to maintain substantially constant oscillator frequency. These spacers are preferably that of "Isolantite," fused quartz, or any other suitable material having similar characteristics, although "Isolantite" has been found satisfactory in certain typical applications. Spacing pillars 8 are retained in position by any suitable means, such as for example pins 9, which are driven into electrode 1. A circular or ring-like insulating casing 11 forms the side walls of the holder to which is secured by means of screws 10 an insulating cover plate 12. The upper electrode 2 is held firmly against the spacer blocks 8 by coil springs 15 which are retained in position by the centering pins 16 attached to electrode 2, and likewise a similar pin, if desired, may be inserted in the top cover plate 12. Electrical connections to the electrodes may be made by means of a flexible lead 13 to a terminal screw 14. The other electrical connection is made from the lower base electrode 1 by means of a screw (not shown) threaded into hole 17. The casing ring 11 is secured to base electrode 1 by means of three round head screws 18, which are tapped into the metallic base 1.

Although Fig. 2 shows a circular space for retaining a rectilinear crystal, it is to be understood that other shapes, such as a three-sided crystal or a circular crystal and an oval space or vice versa, may also be used to minimize the damping by retaining the crystal on the lower electrode at its extreme ends. Therefore, this invention should not be limited to the precise arrangement shown.

What is claimed is:

1. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a rectilinear shaped piezo-electric crystal interposed between said electrodes, retaining means including a drop of cement located at two corners of said crystal, means

for maintaining said crystal spaced with respect to both of said electrodes to obtain extreme frequency stability when the crystal is used in an oscillatory circuit.

2. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a rectilinear shaped piezo-electric crystal interposed between said electrodes, means including a circular depressed space in said lower electrode, the diameter of which is greater than the width of the crystal but less than its diagonal, for maintaining said crystal spaced by its extreme corners with respect to both of said electrodes to obtain extreme frequency stability when the crystal is used in an oscillator circuit.

3. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a rectilinear crystal, means including a depressed aperture in said lower electrode, the area of which is such that at least two corners of the crystal rest above said aperture, and a drop of cement located at at least two corners of said crystal to retain it in position on said lower electrode.

4. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a rectilinear shaped piezo-electric crystal interposed between said electrodes and having a space between it and an adjacent face on said upper electrode, means including a circular depressed space in said lower electrode, the depth of said depressed space being substantially equal to the space between the upper electrode and the adjacent face of said crystal and the diameter of which is greater than the width of the crystal but less than its diagonal, for maintaining said crystal spaced by its extreme corners with respect to both of said electrodes to obtain extreme frequency stability when the crystal is used in an oscillator circuit.

5. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a rectilinear crystal, means including a depressed aperture in said lower electrode, the area of which is such that at least two corners of the crystal rest above said aperture, two insulating blocks, each one of which is located near two corners of the crystal, and means interposed between the insulating block and crystal corners to retain it in position on said lower electrode.

6. A piezo-electric crystal holder comprising an upper electrode, a rectilinear crystal, a lower electrode spaced from said upper electrode, said lower and upper electrodes being made of an alloy having a temperature coefficient of expansion very close to that of said crystal, means including a depressed aperture in said lower electrode, the area of which is such that at least two corners of the crystal rest above said aperture, and a drop of cement located at at least two corners of said crystal to retain it in position on said lower electrode.

7. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a rectilinear shaped piezo-electric crystal interposed between said electrodes and having a space between it and an adjacent face on said upper electrode, means including a circular depressed space in said lower electrode, the depth of said depressed space being substantially equal to the space between the upper electrode and the adjacent face of said crystal.

8. A piezo-electric crystal holder comprising an upper electrode, a lower electrode spaced from said upper electrode, a square-shaped piezo-electric crystal interposed between said electrodes and having a space between it and an adjacent face of said upper electrode, means including a circular depressed space in said lower electrode, the depth of said depressed space being substantially equal to the space between the upper electrode and the adjacent face of said crystal, and a drop of cement located at at least two corners of said crystal to retain it in position on said lower electrode.

HAROLD O. PETERSON.
PAUL V. WINANS.