

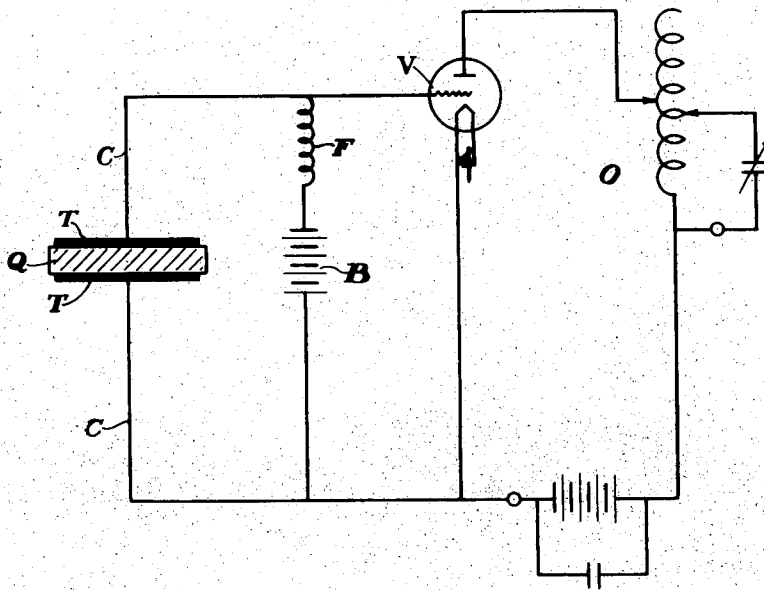
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PIEZO ELECTRIC CRYSTAL

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PIEZO-ELECTRIC CRYSTAL

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My invention relates broadly to piezo-electric crystals and more particularly to the mounting of crystals and the provision of terminals and loaded films thereon for establishing connection with the surface of the crystals and determining the frequency of operation thereof in vacuum tube circuits.

The object of my invention is to provide an arrangement of terminals for piezo-electric crystals.

Another object of my invention is to provide a conductive coating for opposite faces of the piezo electric crystal in such a form and mass that the frequency of oscillation of piezo-electric crystals may be fixed within certain limits.

A further object of my invention is to provide a coating of metal on a crystal to produce a crystal unit having a zero coefficient of frequency change per degree change of temperature.

Oscillator systems utilizing a crystal to control the frequency provide a means for holding the crystal between flat plates. Experience has indicated that films of oil, dust, etc. destroy the oscillating properties of the crystal and the experience has led to the inference that metallic films or firmly adhering coatings would have the same inhibitory action. I have discovered, however, that metallic films when deposited by cathode sputtering, by chemical methods, or a like process, do not have a deleterious effect on the crystal but on the contrary the coatings seem to share to a greater or less extent the vibrations of the crystal making it possible for the crystal so coated to be used advantageously as a generator of sustained oscillations.

I have also discovered that the frequency of oscillation of a coated crystal may be selectively fixed by varying the thickness of the films or by securing to the films other materials by any suitable process such as soldering.

I have further discovered that by selecting suitable metals to be used as the coating, the temperature coefficient of frequency change may be made to be zero, an important factor in the operation of crystal controlled circuits where the temperature of the appa-

ratus may vary from time to time which ordinarily in the case of electrodes merely resting in contact with the surfaces of the crystal would tend to cause a frequency shift.

The preferred location of the films is upon the opposite sides of the crystal but I do not limit myself to such locations for the films may cover the crystal entirely or only in part or by adding metal, such as solder, on a part of the coatings.

The single figure of drawing shows a crystal having coated surfaces according to my invention.

My invention has been illustrated in the attached diagram wherein the electron tube V is shown with its electrodes connected in circuit with the piezo electric crystal frequency determining system and with the oscillator circuit O. The frequency determining circuit includes the piezo electric crystal Q having the films T deposited on opposite faces thereof in intimate contact with the crystal surface throughout the area thereof, each of the films being of such predetermined thickness as will selectively fix the operating frequency of the piezo electric crystal. Conductors C extend between the electrodes T and the input electrodes of the electron tube oscillator V. The choke coil F and biasing battery B are arranged in series and connected across the terminals of the piezo electric crystal Q.

The films T are deposited on the piezo-electric element Q in such a way as to provide a layer of metal impregnated in the surface of the crystal. These films increase the efficiency of operation of the crystal as shown by the increased output of the circuits using crystals coated in the manner herein disclosed. This increase in efficiency may be due to several causes, such as the elimination of brush discharge, leakage, or perhaps the concentration of the components of the stray oscillations within the crystal into oscillations along the desired axis.

Furthermore, the selection of the metal used, and the selection of the thickness of the metal film in relation to the dimensions of the crystal are important factors in the determination of the constants of the resultant

crystal unit. By the variation in the constants of the metal film, a crystal may be controlled to operate the same or differently under the varying conditions of operation, which varying conditions, for example, may be a broad range of temperatures. Under the ordinary conditions of operation it is most desirable to have a crystal that will insure a constant frequency irrespective of the varying temperature conditions under which it is operating.

With my system of coating crystals the wires that connect the crystal into the circuits in which it may be used, may be secured to the films by solder or other like methods, thus assuring a lower contact resistance than has heretofore been known.

Having thus described my invention what I claim as new is:

1. A piezo electric crystal, metallic films deposited on the surfaces of said crystal, said films each adhering intimately to said crystal and having a thickness proportioned to the natural frequency of the unloaded crystal and the desired frequency of the loaded crystal for selectively fixing the frequency of operation of said crystal.

2. A piezo-electric crystal having a cathodically deposited coating of metal upon each of its electrode surfaces, the thickness of at least one of the coatings determined by the fundamental frequency of the piezo-electric crystal and by the desired resonant frequency of the coated crystal.

3. A piezo-electric crystal having a cathodically deposited coating of metal upon each of its electrode surfaces, the thickness of each of the coatings determined by the fundamental frequency of the piezo-electric crystal and by the desired resonant frequency of the coated crystal.

4. The method of adjusting the free vibration period of a piezo electric element which comprises grinding said element to a thickness slightly less than that corresponding to the free vibration period desired for said element, and applying a conductive coating to a lateral surface of said element for changing its free vibration period to the desired value.

5. The method of adjusting the free vibration period of a piezo electric element which comprises grinding said element to a thickness slightly less than that corresponding to the free vibration period desired for said element, applying a metallic coating to a lateral surface of said element, and adjusting the average thickness of said coating and element to a value corresponding to the desired free vibration period.

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