

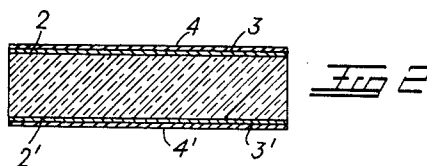
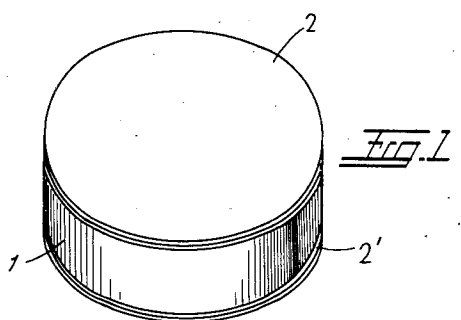
Oct. 12, 1937.

R. BECHMANN

2,095,376

PIEZOELECTRIC OSCILLATOR CRYSTAL

Filed Sept. 9, 1935



BY

INVENTOR.
RUDOLF BECHMANN

H.S. Grover
ATTORNEY.

UNITED STATES PATENT OFFICE

2,095,376

PIEZOELECTRIC OSCILLATOR CRYSTAL

Rudolf Bechmann, Berlin, Germany, assignor to
Telefunken Gesellschaft für Drahtlose Tele-
graphie m. b. H., Berlin, Germany, a corpora-
tion of Germany

Application September 9, 1935, Serial No. 39,796
In Germany November 24, 1934

7 Claims. (Cl. 171—327)

This invention is concerned with a piezo-electric oscillator arrangement in which the electrodes consist of metallization of the active or working surfaces of the crystal.

It has been suggested in the earlier art to make the electrode surfaces of a piezo-electric oscillator or resonator by having the active areas of the crystal metallized. However, this method was soon abandoned for the reason that the crystal, after being in operation a comparatively short time, was found to lose its oscillation powers or experienced changes in frequency. Now, the present invention is predicated upon the idea and proper appreciation of the fact that these unfavorable results were ascribable to the circumstance that the electrode surface was destroyed or impaired by extraneous influences such as atmospheric humidity or thermal conditions inside the crystal holder.

According to this invention, the electrode surfaces are made by applying a coat of heat and humidity resisting material upon the active surfaces of the crystal and being of a kind which will not suffer oxidation. Materials suited for this purpose are gold, platinum, and chromium.

In order to insure particularly good sticking or adhesion of the metallic coat upon the crystal, the said coat is applied in two or more thin layers rather than a heavy layer being applied all at once. Experience has shown that especially favorable results are obtained if at least the bottom coat or substratum adjacent the surface of the crystal is produced by way of cathode disintegration. This bottom coat could consist also of other or dissimilar metals, e. g., silver, while at least the outermost or top coat consists of other metals presenting heat and humidity resisting qualities, as mentioned above.

To a certain extent, the frequency of a crystal oscillator is also dependent somewhat on the thickness of the metallic coat. The latter, as it were, represents a load or impediment for the mechanical oscillable system in such a way that with changing thickness of the coat the mass of the oscillator increases, and this means a reduction in the natural frequency of the structure or oscillating system. This phenomenon is encountered in all kinds of crystal oscillators; it is only the magnitude of its influence upon the natural frequency of the various forms of oscillation which are possible to obtain in a given crystal. In the light of this situation it will be obvious that with the use of metals which are not stable in reference to humidity actions, the mass of the oscillable structure, for instance, may undergo

a change by oxidation of the metal and thus a structural change in the metallic coat or layer occurs.

According to the invention, these conditions are utilized for the practical purpose to cause the frequency of the oscillable crystal to assume a value that may be fixed with a high degree of precision. This method is particularly adapted to the said object for the reason that, on the one hand, the thickness or depth of the metallic coat is producible with a good deal of exactitude, while on the other hand, any desired slight variation of the coat thickness is obtainable. To make the metallic coat, apart from the cathode disintegration hereinbefore mentioned, there is suited also the process predicated upon the vaporization of metal in vacuo as well as the application of the coat inside an electrolytic bath. In this case it is possible to exactly determine and gauge the thickness of the layer by measuring and controlling the length of action of the application or filming process.

One exemplified embodiment of the basic idea of the invention is shown in the attached drawing in which Fig. 1 is a perspective view of the crystal with metallic films and Fig. 2 is a cross-sectional view of Fig. 1. Referring now in detail to the drawing, 1 denotes a circular plate made of a kind of material possessing piezo-electric properties, such as quartz crystal. The active surfaces of the crystal consist of the flat faces of the disk 2 and 2'. Applied upon each of the active surfaces are metallic coats 3, 4, and 3', 4', respectively, at least the top layers 4 and 4' consisting of a non-oxidizing metal having heat and humidity resisting qualities, e. g., gold, platinum, or chromium; whereas the lower layers 3 and 3', respectively, may consist of a different metal having a lower melting point and subject to greater oxidation but having better electrical conducting properties, such as silver.

Having thus described my invention, what I claim is:

1. A piezo-electric crystal oscillator having a plurality of metallic films to act as the electrodes, with this characteristic feature that each one of the metallic films consists of at least two different metallic conducting layers of which at least the topmost one is made of material which resists heat and humidity actions.

2. An oscillator crystal according to claim 1, with this characteristic feature that the topmost layer consists of a film of gold.

3. An oscillator crystal according to claim 1

with this characteristic feature that the topmost layer consists of a film of platinum.

4. An oscillator crystal according to claim 1 with this characteristic feature that the topmost
5 layer consists of a film of chromium.

5. A piezo-electric crystal oscillator having a plurality of metallic films to act as electrodes with this characteristic feature that each one of the metallic films consists of at least two different
10 metallic conducting layers of which the layer in intimate contact with the crystal is of silver and the topmost layer is of gold.

6. A piezo-electric crystal oscillator having a plurality of metallic films to act as electrodes with

this characteristic feature that each one of the metallic films consists of at least two different metallic conducting layers of which the layer in intimate contact with the crystal is of silver and the topmost layer is of platinum.

7. A piezo-electric crystal oscillator having a plurality of metallic films to act as electrodes with this characteristic feature that each one of the metallic films consists of at least two different metallic conducting layers of which the layer in
10 intimate contact with the crystal is of silver and the topmost layer is of chromium.

RUDOLF BECHMANN.