April 22, 1958 W. IANOUCHEVSKY 2,831,989

CRYSTAL SUPPORT

Filed Feb. 17, 1955

Fig. 1

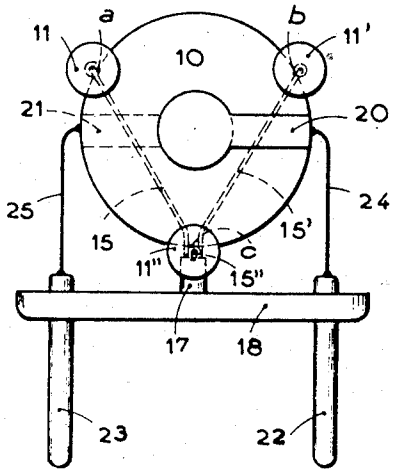
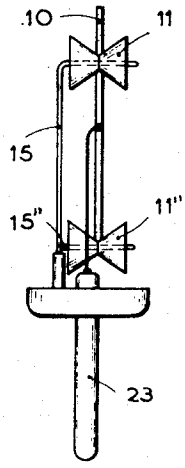


Fig. 2



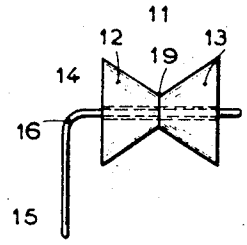
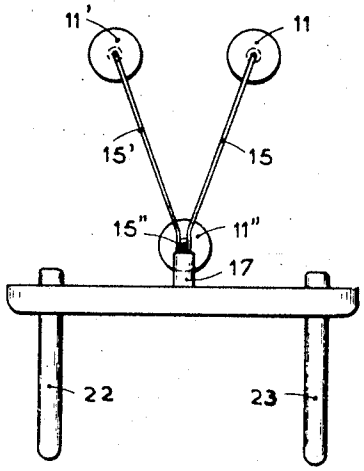


Fig. 3

Fig. 4



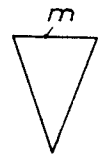


Fig. 5

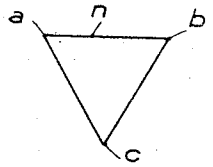


Fig. 6

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CRYSTAL SUPPORT

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4 Claims. (Cl. 310—9.1)

It is well known that the quality of a piezo-electric crystal depends in large part on the manner in which the crystal is suspended.

In present piezo-electric technique, quartz crystals are used in the form of small discs having electrodes formed by an extremely thin metal coating deposited on the crystal by evaporation in vacuo or by particle bombardment.

Usually the diameter of the metallic coating deposited over each face of the crystal is substantially less than the diameter of the disc. In order to ensure electrical connection with the connector terminals of the support, narrow strips are provided which extend the metal coating as far as the periphery of the disc.

Secured to the terminal pins of the support are connecting wires terminating in a pair of loops. The quartz disc is pinched or clamped between these loops of wire at the points where the strips terminate.

Because such contact is insufficient the contact surface is coated with a conductive cement which usually comprises a fine powdered silver and Bakelite mixture.

The suspension system just described has serious drawbacks, for two reasons:

(1) The conductive cement is not a pure metal and therefore introduces an additional resistance which is variable with time and temperature conditions, thereby affecting the over-voltage coefficient of the crystal.

(2) The connections supported by the quartz disc between the loops of wire exert a mechanical force on the crystal, usually a twisting couple, which also is variable with time and temperature.

Vibrations are also apt to modify the mechanical strain sustained by the quartz.

This invention has as its object to eliminate the difficulties just mentioned.

It is an object of the invention to provide a support for a piezo-electric crystal, whereby the crystal is maintained without being subjected to any mechanical stresses or strains liable to affect the oscillations generated thereby.

It is also an object to provide a crystal mounting such that the piezo-electrical characteristics of the crystal will remain constant with time and also with varying temperatures.

It is also an object of the invention to provide a crystal mounting device which will be unaffected by vibrations even over long periods of time.

Another object is to provide a crystal mount which will be easy to construct and will provide for ready positioning of the crystal in its support.

In the ensuing description, made by way of example, reference is had to the accompanying drawings, wherein:

Fig. 1 is a front elevational view;

Fig. 2 is a side elevational view;

Fig. 3 is a view of a supporting member on an enlarged scale;

Fig. 4 is a front view of the support prior to the mounting of the crystal therein;

Fig. 5 is a diagram;

Fig. 6 is a similar diagram relating to another condition.

The crystal disc **10** is supported from three points *a*, *b* and *c* on the nodal plane. As an illustrative example of an operative embodiment of the invention, the three points may be physically defined by parts having a circular configuration in cross section. One such part is shown at **11** and is formed with two similar frustoconical surfaces **12** and **13** having aligned axes, connected at their smaller diameter ends to provide a spool-shaped member. The part is formed with an axial bore and through the bore is threaded one leg **14** of a rod or wire **15** formed with a bend **16**. The rod **15** is rigidly connected with the spool member **11** either by means of an adhesive bond or by a force fit of the leg **14** into the bore of the spool member.

The parts such as **11** are made from a material possessing substantially less hardness than the crystal so as to prevent the transfer or coupling of energy to the support and avoid damping the crystal's oscillations. Thus the parts such as **11** may be made of plastic material.

The rods **15**, **15'** and **15''** having the members **11**, **11'** and **11''** fixed to the ends thereof possess some inherent resiliency. Thus they may consist of annealed lengths of wire having low stiffness. The wires or rods are secured to a post **17** projecting from the base **18**. The wires **15**, **15'** and **15''** are secured to the post **17** as by solder or by being clamped between a pair of metal strips.

The free ends of wires **15**, **15'** and **15''** or more precisely the "throat" sections of the spool members, substantially define the apices of an isosceles triangle as illustrated in Fig. 5.

In order to insert the disc **10**, the legs **15** and **15'** are spread apart, this being made possible owing to their resiliency; then the disc is inserted and applied over the spool member **11''**, whereupon the legs **15** and **15'** are released to retain the disc under the slight pressure exerted by the spool members **11** and **11'** secured on said legs.

The isosceles triangle having the base *m*, formed by the sections **19** when the disc is not in place, becomes changed to an isosceles triangle as illustrated in Fig. 6 wherein the side *n* is larger than the original side *m*.

The electrical contact between the extremities of the metal-coating strips **20** and **21** and the pins **22** and **23**, is provided by two conductor wires **24** and **25** soldered at one end to the pins **22** and **23** and at the other end to the strips coated on the surface of the crystal.

A similar method of suspension embodying parts which provide a mechanical engagement with the crystal in the form of frustoconical elements arranged in opposed relationship and secured on resilient wires, may be applied in connection with the suspension of rectangular crystal elements, by the use of four or six suspending legs. The method may likewise be used in suspending crystal elements of different configuration, by appropriately modifying the shape of the legs and increasing their number where necessary.

What I claim is:

1. Piezo-electric device comprising a plate-like piezo-electric crystal and holding means including three holding elements for holding the plate-like crystal cooperating exclusively with the edge thereof, a first electrode on a face of the crystal and a second electrode on another face of the crystal, a collar supporting said holding means, and means electrically connecting the electrodes and the collar.

2. Holding device for a piezo-electric crystal comprising a collar, a first holding element fixed on said collar having two faces inclined to one another to cooperate with the edge of the crystal for the support of the same,

two other holding elements each including two faces inclined with respect to another to cooperate with the edge of the crystal, means fixed to the collar each including one of the second-mentioned holding elements, the same being placed at a greater distance from the collar than the first holding element.

3. Holding device according to claim 2, in which resilient wires are fixed to the collar and in which each of the second-mentioned holding elements is carried at the end of one of the resilient wires, the resiliency of the wires assuring engagement of the holding elements against the edge of the crystal.

4. Holding device for a plate-like piezo-electric crystal comprising a fixed collar, a first holding element including two frustro-conical surfaces secured at their small bases, two other holding elements constituted by two frustro-conical surfaces secured at their small bases, the said common bases of the three holding elements being disposed in a common plane.

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