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HORIZONTAL CRYSTAL MOUNT

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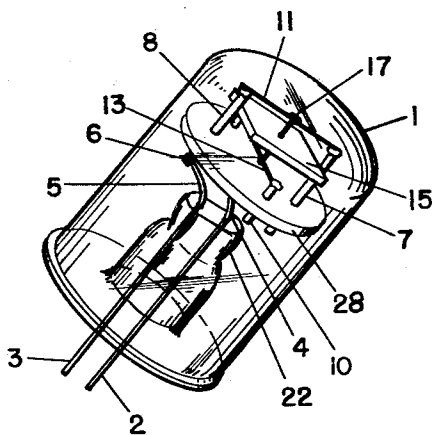


FIG. 1.

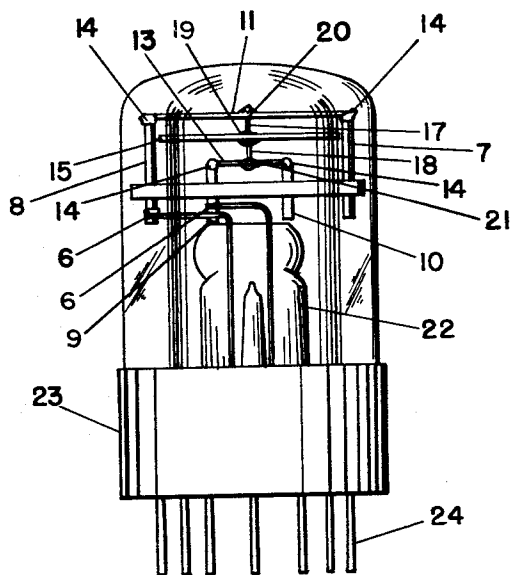


FIG. 2.

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HORIZONTAL CRYSTAL MOUNT
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This invention relates to piezoelectric crystals and mounting means therefor and particularly to such crystals which are mounted in a horizontal position so as to withstand high vibration and shock conditions.

Piezoelectric crystals are in wide spread use in many forms of electronic equipment and the physical arrangements for supporting these crystals in the circuits in which they are used have been studied in great detail. Two aspects of crystal support are particularly important. Due to the fact that these units are used in equipment such as high speed aircraft missiles and satellites, it is highly important that they be of a minimum size in order to take up the least possible space in such structures. The use of these units for the above stated purposes also means that the units will be subjected to high acceleration vibration and shock. Therefore, these crystal units must be mounted in a manner which will withstand such extreme vibration and shock and still operate properly and accurately.

Almost all of the rugged mounts in use today support the crystal in a vertical fashion due to the fact that no satisfactory manner has been found by which the crystals can be supported in a different plane. Since the crystals are usually of a disc shape it can be seen that mounting the crystal in a horizontal fashion rather than a vertical fashion would allow the reduction of the height of the enclosing case without increasing another dimension of the case.

Units have been designed to support crystals in a horizontal fashion but in every case the horizontal type of mounting has been attained at the expense of the ability of the unit to withstand vibration and shock.

Accordingly, it is an object of this invention to provide a horizontal crystal mount which will withstand high acceleration vibrations and shock.

Another object of this invention is to provide a symmetrical mount of reduced dimensions without sacrificing any of the desirable mounting features.

Yet another object of this invention is to mount the crystals within a glass envelope in order to attain less contamination and less leakage, whereby the inert qualities within the envelope result in reduced aging of the unit.

A further object of this invention is to provide crystal units which are easily processed up to and including the enclosing of the units within the glass envelope.

A still further object of this invention is to provide a horizontal crystal mount which may be used with various types and sizes of crystal units.

In accordance with the present invention there is provided a hermetically sealed piezoelectric unit wherein conductive support members are secured to the glass header of an evacuated envelope and the crystal unit is conductively connected between these support members by a "center wire mount" connection. There is further provided a means such as a mica disc or subheader between the crystal unit and the glass header of the tube for maintaining the support members in a fixed spatial relationship.

For a more complete understanding of the present invention reference is made to the following detailed description of a particular embodiment of the invention as applied to a horizontally supported crystal. The description and the accompanying drawings are to be considered

as illustrative of the principles of the invention which can readily be applied to other embodiments without departing from the scope of the invention.

In the drawings, wherein like components are given like numbers:

FIG. 1 is a perspective view of a particular embodiment of the invention showing a horizontal crystal mount; and

FIG. 2 is a side elevational view of the unit of FIG. 1 with a base attached.

Referring now to FIGS. 1 and 2 a horizontally mounted crystal and the unit therefor is shown as comprising an evacuated glass envelope 1 having a header 22 through which leads 2 and 3 extend. In order that the leads shall have sufficient strength to support the crystal mount, the upper ends 4 and 5 of leads 2 and 3 are of wire having an increased diameter and are bent as shown. The main support for the crystal 15 is provided by the vertical support members 7, 8, 9 and 10 which are made of an electrically conductive material. In addition to supporting the crystal, supports 8 and 9 further provide the electrical connections from the leads 2 and 3 and are welded thereto at points 6. Electrically conductive cross member 11 is placed between support members 7 and 8 and welded thereto at 14. In the same manner cross-member 13 is welded to support members 9 and 10.

In order to supply the necessary rigidity and spatial relationship between support members 7, 8, 9 and 10, a non-conductive disc member 28 is placed between leads 2 and 3 and the upper parts of supports 7, 8, 9 and 10. The method of securing the support to the disc generally depends upon the material used for the disc. If a glass disc is used for the sub-header 28, the support members may be molded in the disc at the time it is formed. When a mica disc is used, metal eyelets may be inserted in the openings in the disc with the support members subsequently welded to the eyelets.

The connections are provided for the crystal in a "center wire mount" fashion. In this type of mount, the crystal plate 15 is positioned between the cross-members 11 and 13 and supported by two lead wires 17 and 18. The lead wires 17 and 18 are soldered at 19 to the opposite sides of the crystal directly to the metal plating on the major surfaces thereof. The lead wires 17 and 18 are also connected to the cross wires 11 and 13 at a position to assure that the lead wires are at nodal points. This distance is measured from the point where the lead wire comes out of the solder connection on the face of the crystal unit to a point 1/4 wave length along the lead wire. This distance is dependent upon the wire diameter, wire material, and the frequency of the crystal plate. With this type of mount the lead wires perform the dual function of supporting the crystal and supplying the electrical leads thereto.

FIG. 2 shows the enclosed envelope with an attached base 23 including prongs 24. Although an Industry Standard seven pin miniature tube base is shown for illustrative purposes, it is obvious that any base may be used to fit the particular requirements of the socket to be used. The base is attached to the envelope with an epoxy adhesive.

The crystal unit of this invention, as exemplified by FIGS. 1 and 2, has proved to be superior in many aspects to the crystal units generally in use. The fact that the crystal is mounted in a horizontal fashion provides a considerable reduction in the height of the tube without increasing the diameter of the tube. Further, this type of horizontal crystal mount is applicable to both square and round face flexure "center wire mount" crystal units.

The manufacture of these tubes has also been greatly simplified over that of prior methods. The units them-

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selves are built up from the subheader or insulating disc and completed prior to the enclosing stage by using the subheader as a mounting base for the supports in the crystal unit. The unit is then enclosed in an evacuated glass envelope with the leads extending therefrom. The use of the glass envelope provides less contamination, less leakage and the inert qualities within the envelope result in reduced aging of the crystal unit.

The value of this type of mount, and particularly the use of the subheader or disc member to provide the necessary rigidity, is clearly shown in tests wherein the crystal withstood high acceleration vibration and shock over an extended period of time. The arrangement of the lead wires, supports and the subheader also serves the purpose of reducing shunt and loading capacitance.

It is to be noted that the number of supports and their shapes, and the use of one or a plurality of subheaders may be varied to provide the degree of support necessary to meet any specification requirements. As an example, the support members, instead of having the inverted U shape as shown in the drawings, could have a simple L shape with the lead wires being attached to the outer end of the L formed by each of the supports. Also, the cross-wire mounts such as 11 and 13 in FIGS. 1 and 2 could have bends therein if it were desired to have a slight spring reaction in the mount. Additional supports could also be provided by using extra wire mounts extending from the header of the tube to the subheader or insulating disc. The crystal unit could also be made using two insulating discs if such additional rigidity is desired.

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Throughout this specification and claims the terms crystal and piezoelectric crystal are to be interpreted in their broad sense and not limited to any particular crystal since many materials exhibit properties which render them adaptable to the mounting features of the invention.

Many modifications will now be apparent to those skilled in the art in the light of the present teaching and the invention thereof is considered to include such modifications within the scope of the appended claims:

We claim:

1. A piezoelectric unit comprising a hermetically sealed envelope having connection leads extending therethrough, a first conductive inverted U-shaped member connected at one end thereof to one of said leads, a second conductive inverted U-shaped member connected at one end thereof to the other of said leads, a piezoelectric crystal unit, conductive means connected between the closed portions of said inverted U-shaped members and said crystal unit, and a rigid disc between said crystal unit and said leads, the legs of said inverted U-shaped members extending through said disc.

2. The apparatus of claim 1 wherein said crystal unit is mounted in a plane substantially perpendicular to the legs of said inverted U-shaped members.

3. The apparatus of claim 2 wherein the disc is substantially parallel to said crystal.

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