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J. F. BARRY ET AL

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CRYSTAL UNIT

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FIG. 1

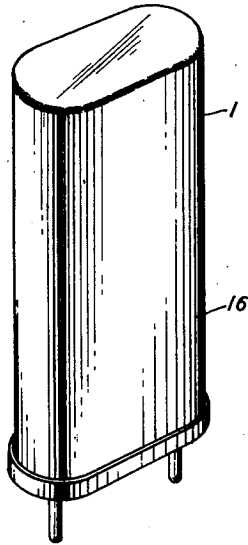


FIG. 2

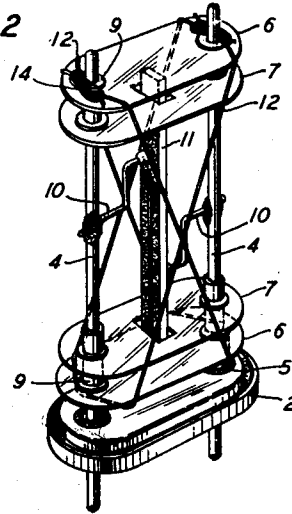


FIG. 3

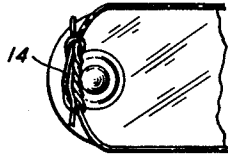


FIG. 4

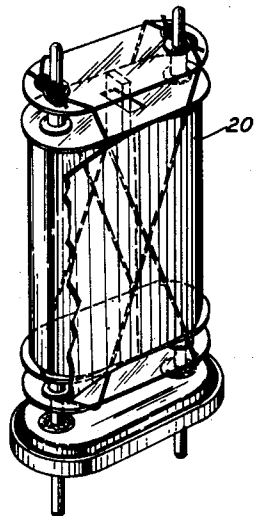
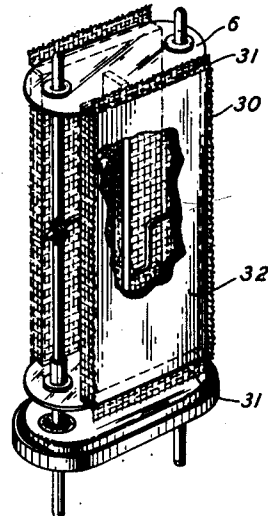


FIG. 5



INVENTORS: J. F. BARRY
D. M. RUGGLES
BY

J. F. Barry

ATTORNEY

UNITED STATES PATENT OFFICE

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CRYSTAL UNIT

Joseph F. Barry, Summit, and David M. Ruggles,
Mount Tabor, N. J., assignors to Bell Telephone
Laboratories, Incorporated, New York, N. Y., a
corporation of New York

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4 Claims. (Cl. 310—8.2)

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This invention relates to piezoelectric crystal units and more particularly to such units of the type including a crystal mounted within a sealed housing and in spaced relation to the inner walls thereof.

In crystal units of the type above mentioned and particularly in those intended for operation at relatively low frequencies, say from about 1 to 100 kilocycles, serious degradation in performance may obtain as a consequence of the establishment of standing waves within the housing. One effect of such waves, especially pronounced when the spacing between the faces of the crystal and the interior housing walls is equal, or substantially so, to a half wavelength, or odd multiple thereof, of the operating frequency, is substantial dissipation of the crystal energy, whereby oscillation of the crystal is impaired or even stopped.

Ways have been proposed heretofore for overcoming these deleterious effects. However, these ways have been found to be not satisfactory, being either uneconomical or impractical, or both, particularly where quantity manufacture of crystal units is involved.

One general object of this invention is to improve the performance characteristics of piezoelectric crystal units of the sealed housing type.

More specific objects of this invention are to prevent the establishment of standing waves in such units and to enable and facilitate the fabrication in quantity, and economically, of crystal units free from standing wave difficulties.

In accordance with one feature of this invention, means are provided within the housing for simultaneously absorbing and dispersing transmitted and reflected waves within the housing, thereby to prevent the setting up of standing waves, without substantial abstraction or loss of the vibrational energy of the crystal.

More specifically, in accordance with one feature of this invention layers of soft fibrous material, for example of a creped paper known commercially as "Kimwipe," which does not shed fibrous material or lint that might adhere to the crystal and interfere with or alter vibration of the crystal are mounted upon the crystal supporting structure in prescribed relation thereto and in such manner that no strains are introduced in this structure.

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The material not only abstracts energy from the waves, expended in flexing the fibres of the paper, but, in addition, tends to diffuse the waves and spread the paths so that there is less tendency for direct reflection back to the identical area of the crystal from which each portion of the waves originated. As many layers of the paper may be wound around the supporting structure as may allow convenient insertion into the housing. In the average case, this will involve five or six layers of paper surrounding the crystal and the cradle.

The form of the supporting structure or cradle for the fibrous material is of substantial importance, since even slight pressure against the supporting rods for the crystal unit tends to produce a change in the stresses in the mounting wires to which the crystal is directly affixed. Any change in stress in the mounting wires results in significant changes in crystal frequency. The invention comprehends a simple form of support for the absorptive material, which keeps it out of contact with the crystal and yet may be used without introducing objectionable strains and frequency changes. In one particular advantageous form, the supporting structure includes an X-shaped cradle of nylon cord extending outside the mica spacers and held against diagonally opposite support rod portions. The nylon cords are tied with fisherman's knots adjacent the portion of the supporting rods passing through the mica spacer. The cord is tied tight enough to prevent sagging of the paper sufficient to touch the crystal but not tight enough to cause significant bending stress in the "straights" or vertical support rods. If the crystal unit is of a type which utilizes one or more mica bumpers in addition to mica spacers at each end of the "straights," the cord is preferably carried around the outer mica spacers of the array. The paper, which is applied as a strip and wound around the cradle, should be of such a width as to substantially fill the space between the bumpers, since it has been found that the pressure created between the housing and the mica spacers, during insertion of the crystal unit into the housing may be sufficient to create a bending stress in the straights if the paper is made wide enough to extend over the inner micas.

The invention will be understood more clearly

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and fully from the following detailed description with reference to the drawings, in which:

Fig. 1 is a perspective view of a completed crystal unit embodying the invention;

Fig. 2 is a perspective view of the unit of Fig. 1 with the housing removed, showing the nylon cradle structure;

Fig. 3 is a detail view showing one preferred manner in which the nylon cord is knotted;

Fig. 4 shows the supporting structure of Fig. 2 after a layer of paper has been applied thereto; and

Fig. 5 illustrates another embodiment of the invention.

In the drawings, a typical crystal unit 1 of conventional manufacturing design mounted in a sealed housing or can as shown in Fig. 1 has been adapted to receive sound absorbing means by the addition of a supporting cradle, as shown in Fig. 2. In Fig. 2, the crystal assembly is shown as having a base 2, straights or supporting rods 4 which are fixed in and extend through insulating eyelets 5 sealed to base 2, and mica spacers 6 and mica bumpers 7 fixed on the straights. The function of the mica spacers 6 is to maintain the proper parallel alignment of the supporting rods or straights 4 with substantial rigidity. Rods 4 are conveniently formed of material such as nickel-steel, and the mica spacers 6 are conventionally apertured to receive eyelets 9, which are crimped to the mica and afford a point of attachment, as by means such as spot welding to the rods 4. In the crystal structure shown, additional mica bumpers 7 are provided. While such bumpers are not used in all crystals, in certain types it is necessary to prevent the excessive deflection of the crystal during handling. Such excessive deflections would result in the creation of permanent stresses in the mounting wires 10, which are soldered or welded to the supporting rods 4. The result of strains in the supporting wires 10 is that a stress is introduced at the point of attachment of the wire to the crystal 11, and eventually a failure may result, the most common type being the separation of the supporting wire from the crystal surface. The introduction of such stresses may be prevented by the use of the bumpers 7, which consist of mica spacers apertured to permit the insertion therethrough of the crystal 11. The spacing between the crystal and the apertured mica bumper is sufficient so that there is no interference with the normal vibration of the crystal, but if the unit is roughly handled, the mica bumper will act as a limiting stop and prevent the crystal from moving too far.

The supporting member or cradle for the absorbing paper consists of two loops of nylon cord 12. Each loop extends diagonally across the space occupied by the crystal and about the oppositely disposed corners of the mica spacers 6. Each nylon cord loop is tied adjacent one of the top ends of the support rods 4 by means of a conventional fisherman's knot 14. This knot, shown in detail in Fig. 3, will produce a permanent tie in the nylon cord which is difficult to achieve by other means due to the extremely slippery surface presented by the nylon material.

It is advantageous that nylon or an equivalent material be used in making this cradle, since it has been found that cords of fibrous material tend to separate and lose their proper supporting ability under the continuous vibration to which the crystal unit is subjected and are likewise readily abraded by the edges of the mica

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spacers over which they must pass and by the metal eyelets in the spacer with which they must come in contact. The paper 20 is cut in the form of a strip of substantially the width needed to extend between the bumper micas 7 and is wound around the supporting cradle, as shown in Fig. 4, until as many layers have been applied as can conveniently be inserted into the can cover 16. The creped surface of the paper will cause the successive layers to adhere to each other sufficiently well so that ordinarily it is unnecessary to bind the outer end of the paper strip 20 in place, and the expedient of leaving it free is, therefore, unobjectionable.

Another embodiment of the invention comprises a preformed basket of stainless steel wire into which rectangular layers of paper are inserted. The basket structure, as shown in Fig. 5, is formed of stainless steel wire mesh of eighty openings to the inch or more. The basket 30 is rectangular in form with end portions 31 extending outwardly therefrom in the main plane of the basket and acting as rests against the mica spacers 6 in order to determine the proper alignment of the basket. A sufficient number of rectangular sheets 32 of absorptive material are piled in loosely to fill the baskets and the sheets are retained in position by the can walls 16, as in the case of the layer wrapped around the supporting structure of Fig. 4.

What is claimed is:

1. A crystal unit comprising a base, a crystal, means mounting said crystal from said base, a cover arranged to fit over said crystal and sealed to said base, and means for absorbing supersonic waves within said cover comprising a supporting cradle carried by said mounting means and disposed about said crystal and a plurality of sheets of soft fibrous crepe paper disposed about said crystal and mounted by said supporting cradle.

2. Means for preventing the setting up of standing waves within a crystal container having a base, a crystal, means supporting said crystal from said base, and a cover arranged to be sealed about said crystal onto said base, comprising a supporting cradle formed of cord mounted on said supporting means and extending about said crystal unit and a plurality of layers of fibrous absorptive material disposed about said cradle and mounted thereby.

3. In a piezoelectric crystal unit having a base, a cover arranged to be sealed to said base, supporting and connecting members extending through said base and insulated therefrom, spacing members connecting said supporting members within said cover, and a piezoelectric crystal carried by said supporting members, the combination of means for preventing the setting up of standing waves within said cover comprising a cradle formed of nylon cord tied about said spacers and supporting members and absorptive means comprising a strip of fibrous material of width slightly less than the distance between said spacing members wound about said cradle.

4. A piezoelectric crystal unit comprising a base, a pair of substantially parallel supports extending from said base, a crystal mounted by and between said supports, spacer members in spaced relation on said supports, adjacent the ends of said crystal and extending laterally beyond said crystal, pairs of diagonally arranged intersecting cords extending over opposite sides of said spacer members and affixed to said supports, and multiple layers of fibrous sheet ma-

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terial encompassing said supports and cords and
extending between said spacer members.

JOSEPH F. BARRY.
DAVID M. RUGGLES.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,827,994	Minton -----	Oct. 20, 1931
1,869,178	Thuras -----	July 26, 1932
1,885,062	Micholich -----	Oct. 25, 1932
2,029,358	Clapp -----	Feb. 4, 1936

Number
2,038,804
2,073,951
2,203,322
2,242,755
2,313,379
2,415,832
2,597,797

Number
813,593

6

Name	Date
Roosenstein -----	Apr. 28, 1936
Servias -----	Mar. 16, 1937
Bruzan -----	June 4, 1940
Pope -----	May 20, 1941
Wood -----	Mar. 9, 1943
Mason -----	Feb. 18, 1947
Holmbeck -----	May 20, 1952

FOREIGN PATENTS

Country	Date
France -----	June 3, 1937