Sept. 9, 1941. D. H. C. SCHOLES ET AL 2,255,495

HOLDER FOR PIEZOELECTRIC CRYSTAL ELEMENTS

Filed Jan. 20, 1939

Fig. 1

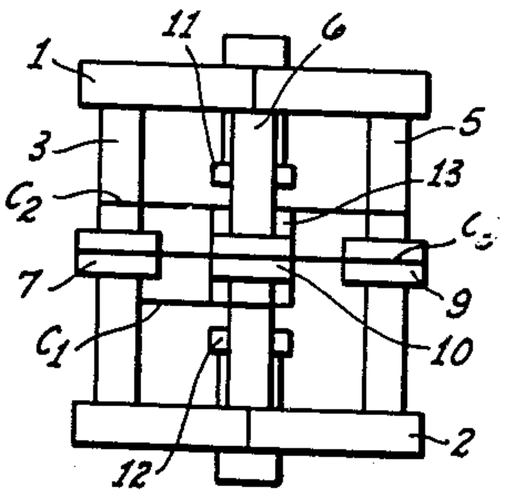


Fig. 2

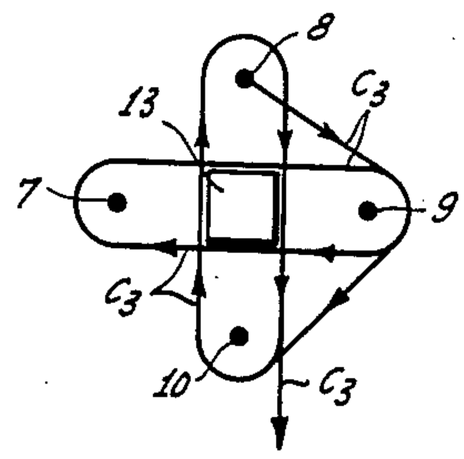


Fig. 3

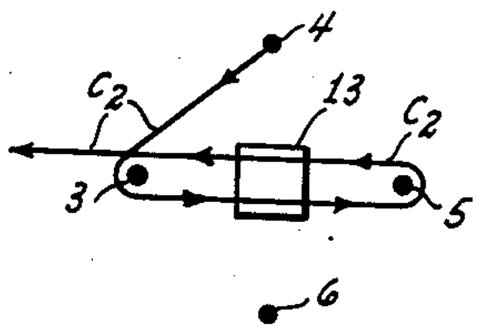


Fig. 4

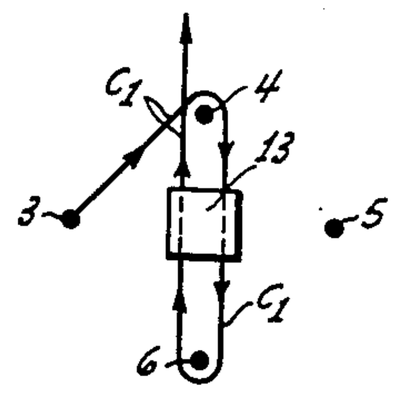


Fig. 5

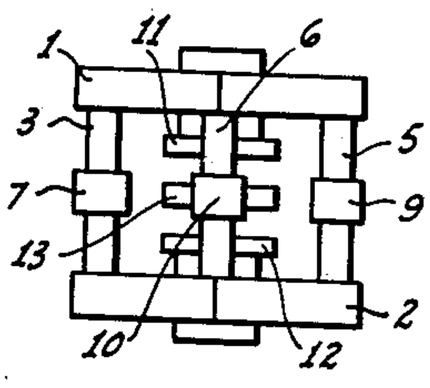


Fig. 6

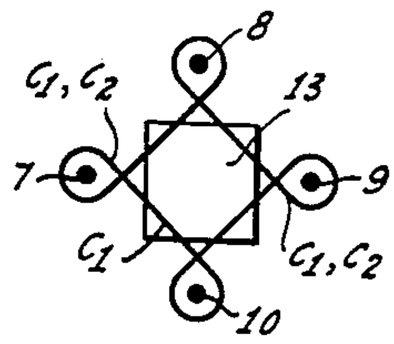


Fig. 7

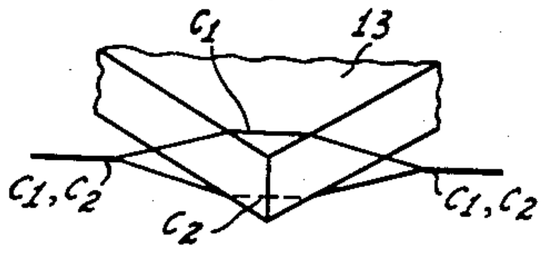


Fig. 8

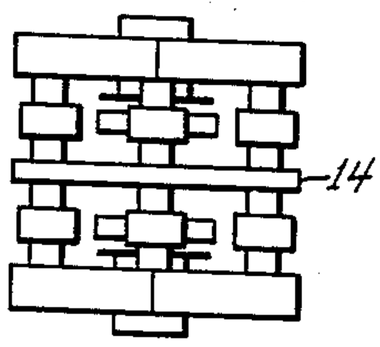
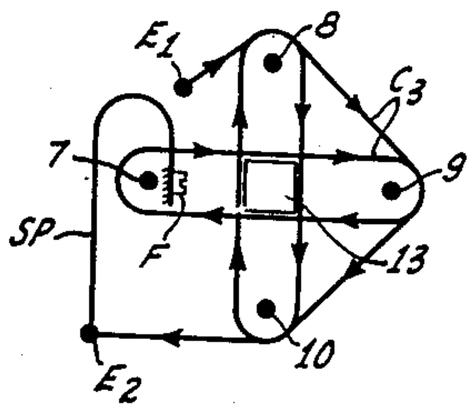


Fig. 9



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HOLDER FOR PIEZOELECTRIC CRYSTAL ELEMENTS

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Application January 20, 1939, Serial No. 251,880
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8 Claims. (Cl. 171—327)

This invention relates to holders for piezo-electric crystal elements.

According to this invention a piezo-electric crystal element is supported from a main frame or carrier member by means including cords or the like which engage the top and bottom faces of the crystal element and thus hold it suspended. The invention offers many advantages as compared to most known crystal holders but probably the most important advantage is that the crystal element can be carried entirely out of contact with anything except the cord or like suspension. If, as is preferably the case in practice, the element suspended by the cord or like means is positioned between two electrodes with an air gap between said element and each of the electrodes, the use of the double air gap results in easy and fine control of the frequency; ensures that expansion and contraction of the main frame or carrier has little effect on the crystal element frequency; and renders the danger of sparking very remote while even if sparking does occur serious damage to the element is improbable. Further, holders in accordance with this invention are cheap and easy to manufacture as compared with most known holders, while they are as efficient in practical use as the best of known holders and substantially as good from the point of view of avoiding adverse effects on frequency and efficiency as a result of rocking or heavy vibration. Furthermore, the holder can be mounted in almost any position and at almost any angle.

The invention is illustrated in the accompanying drawing.

Figs. 1 and 2 show one way of carrying out this invention, Fig. 1 being an elevation of the supporting structure; Fig. 2 shows a diagram of the cord run over four pulleys; Fig. 3 shows a diagram run over two pulleys; Fig. 4 shows a diagram similar to Fig. 3, except that the cord is arranged over two pulleys and at right angles to the showing of Fig. 3; Fig. 5 is a modification of another arrangement of Fig. 1; Fig. 6 shows a diagram of a twisted cord run over four pulleys for securing the crystal at its corners; Fig. 7 is a perspective detail of the arrangement shown by Figs. 5 and 6; Fig. 8 is a still further modification of Figs. 1 and 5; and Fig. 9 is a diagram of a cord run over four pulleys and retained by a spring tension member at one end thereof.

Referring to Fig. 1 and Fig. 2, the crystal element holder therein illustrated comprises a main frame consisting of two parallel spaced insulating plates 1, 2, tied together by four metal rods 3, 4, 5, 6 (rod 4 cannot be seen in Fig. 1 since it is behind rod 6) running at right angles to the planes of the plates and positioned at the corners of an imaginary square. Mounted on each rod mid-way along the length thereof is a pulley 7, 8, 9 10. Pulley 8, of course, does not appear in Fig. 1 since it is behind pulley 10. One electrode 11 is carried by one of the insulating plates—plate 1—and the other electrode 12 is carried by the other, plate 2, these electrodes facing one another and being central with regard to the four rods. A crystal element 13, for example a cubical element, is suspended mid-way between the two electrodes 11 and 12 so as to be spaced from both by means of silk cords arranged in manner now to be described with reference to Figs. 2, 3 and 4 wherein the axes of the rods 3, 4, 5 and 6 are represented by dots: a cord C1 (Fig. 4) upon which the crystal element 13 rests, is run between and round two diagonally opposite rods 4, 6, passing round them below the pulleys thereon; a second cord C2 (Fig. 3) which passes over the element 13, is run between and round the other two diagonally opposite rods 3, 5, passing round them above the pulleys thereon; another cord C3 (Fig. 2) anchored at one end is passed round the pulley 9, then round the pulley 7, then round the pulley 9 to the pulley 10 and then round this pulley to pulley 8, the cord then passing back past the side of pulley 10 to an anchorage at the other end. Thus the element rests on one pair of parallel straight runs of cord (provided by cord C1) and a second pair of straight runs (provided by cord C2) at right angles to the pair on which the element rests, passes over the top of the element, while the vertical sides of the element pass through a square of cord provided by the cord C3 which is passed round the pulleys. The diameters of the pulleys should be suitably selected with regard to the dimensions of the crystal. For example, where a square crystal is used its side should be a trifle less than the pulley diameter so that the crystal element is propely suspended without, however, being pinched by the cords. The arrangement should be such that the crystal is free to move about one thousandth of an inch in any direction.

In a modification, shown in Figs. 5 and 6, a main frame or carrier, as above described, is employed, the carrier consisting of insulating plates 1, 2 tied together with rods 3, 4, 5, 6 having pulleys 7, 8, 9 and 10, thereon. Again as before, the crystal element 13 is suspended midway between two electrodes 11, 12, without touching either by means of cords which are run over the pulleys.

The run of the cords is, however, a little different being as shown by Figs. 6 and 7. In this case, a twisted pair C1, C2 of endless cords is employed, this twisted pair being run round the pulleys in succession in such a direction as to cross itself on the inside of each pulley. Thus, the twisted pair of cords is passed almost right round one pulley 7 (represented in Fig. 6 by a dot); then proceeds to the next pulley 8; then proceeds almost right round this pulley; then proceeds to the next pulley 9 . . . and so on, until the final result is an endless twisted pair of cords passing round the pulleys in succession, the straight runs of cord between adjacent pulleys defining a square which is inside the said pulleys. A crystal plate 13, for example a square crystal plate, is suspended by the twisted pair of cords (as shown best by Fig. 7) by slipping its corner between the cords of the twisted pair about mid-way along the straight runs.

The invention may be extended to provide holders for carrying more than one element. For example either of the embodiments above described may be modified by providing two or more similar cord suspensions carried from the rods by an appropriate number of pulleys thereon, the rods also being used to carry intermediate electrodes between the crystal elements. Thus, for a two-element holder there would be a common electrode carried from the rods about mid-way along the lengths thereof, the two-cord suspensions and the appropriate pulleys therefor being about mid-way between the common electrode and the two insulating end plates. Such an arrangement is shown in elevation in Fig. 8 in which 14 is the common electrode. In view of the description already given, it is thought that further description of Fig. 8 is unnecessary.

If desired, springs may be provided in any of the embodiments to keep the cords in tension. Fig. 9 shows in part a modification with springs for maintaining tension. Here, a cord C3 is anchored at one end E1 and after passing round the pulleys and the crystal 13 as shown is anchored at E2 to the free end of a strip spring SP of J-form, which is anchored at F. Fig. 9 shows only a cord C3 which is equivalent to the cord C3 of Fig. 2. Additional top and bottom cords, run like the cords C1 and C2 of Figs. 4 and 3, respectively, and similarly tensioned by springs, are provided.

What is claimed is:

1. A piezo-electric crystal holder comprising a rectilinear support member, a pair of electrodes, a plurality of rods secured to each corner of said support member, a piezo-electric crystal interposed between said electrodes, said crystal being supported in position between the electrodes by a cord secured to said rods.

2. A piezo-electric crystal holder comprising a rectilinear insulating support member, a pair of electrodes, a plurality of rods located at each corner and at right angles to the plane of said support member and secured thereto, a piezo-electric crystal interposed between said electrodes, said crystal being supported in position between the electrodes by a cord secured to said rods.

3. A piezo-electric crystal holder comprising a pair of insulating plates, a pair of electrodes located within said plates, a plurality of rods secured to said plates, a piezo-electric crystal interposed between said electrodes, said crystal supported in position between the electrodes by a cord secured to said rods.

4. A piezo-electric crystal holder comprising a support member, a pair of electrodes, a plurality of pulleys secured to said support member, a piezo-electric crystal interposed between said electrodes, said crystal supported in position between the electrodes by a cord secured to said pulleys.

5. A piezo-electric crystal holder comprising a support member, a pair of electrodes, four rods secured to said support member, a piezo-electric crystal interposed between said electrodes, said crystal being supported in position between the electrodes by a pair of silk cords secured to said rods.

6. A piezo-electric crystal holder comprising a support member, a pair of electrodes, a plurality of rods secured to said support member, a pulley located on each support rod, a piezo-electric crystal interposed between said electrodes, said crystal supported in position between the electrodes by a cord secured to said pulleys.

7. A piezo-electric crystal holder comprising a support member, a pair of electrodes, a plurality of rods secured to said support member, a piezo-electric crystal interposed between said electrodes, said crystal being supported in position between the electrodes by a cord secured to said rods, and a spring member for retaining said cord in tension.

8. A piezo-electric crystal holder comprising a support member, a pair of electrodes, a pair of rods secured to said support member, a piezo-electric crystal interposed between said electrodes, said crystal being supported in position between the electrodes by a pair of twisted cords secured to said rods, one cord of said twisted pair passing over the top corners of said crystal and the other cord of said twisted pair passing over the bottom corners of said crystal.

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