May 13, 1941. E. L. GARDINER 2,242,120

HOLDER FOR PIEZOELECTRIC DEVICES

Filed June 23, 1940

Fig. 1.

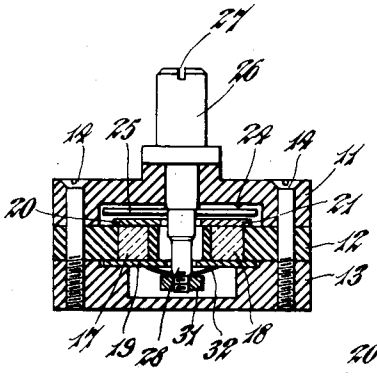


Fig. 2.

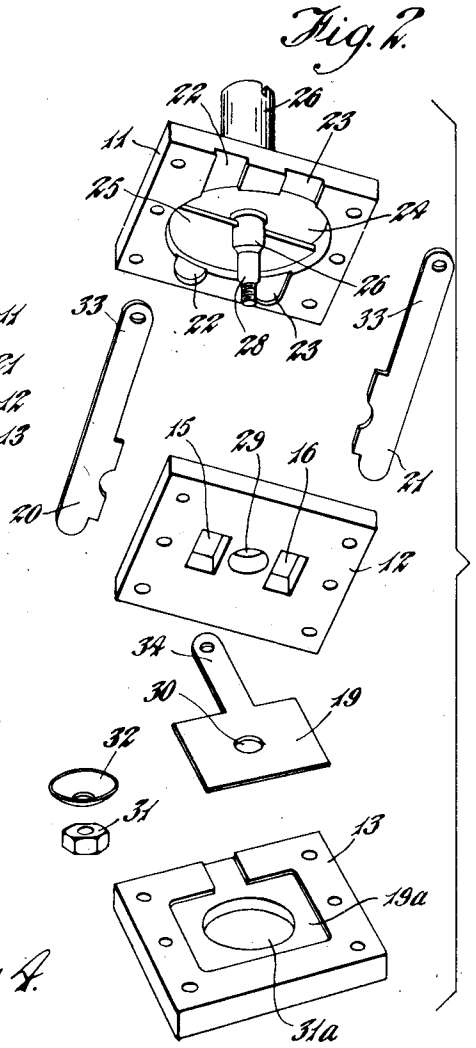


Fig. 3.

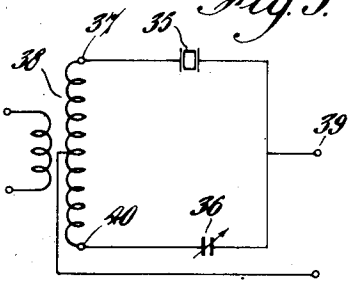
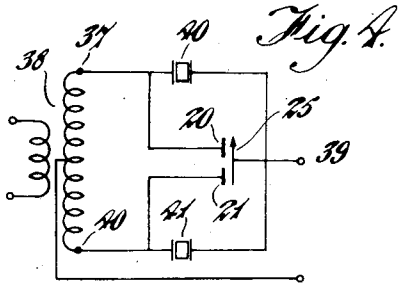


Fig. 4.



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HOLDER FOR PIEZOELECTRIC DEVICES

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4 Claims. (Cl. 171—327)

This invention relates to holders for piezoelectric crystals of the kind which are used as electric oscillators or resonators. In the known form of crystal holder the crystal is held or located between two electrodes, i. e. a first and a second electrode, which usually take the form of metal plates.

In such an arrangement there inevitably exists a certain amount of stray capacity between the crystal electrodes which capacity is, of course, increased when a crystal is placed between these electrodes. This capacity may be considered as being connected in shunt with the crystal and in many applications of a piezoelectric crystal it is most desirable that this capacity, according to the results desired, be either adjusted to a definite magnitude or neutralized out in the known way, e. g. by means of a balanced bridge circuit.

It is accordingly an object of the present invention to provide a crystal holder which is provided with means for adjusting the magnitude of the shunt capacity across the crystal. A further object of the present invention is to provide an improved holder for accommodating a plurality of crystals in which means are provided for adjusting the magnitude of the capacity in shunt with one or more of the crystals.

In accordance with the present invention therefore the improved holder comprising a first and a second crystal electrode is provided with a third electrode which is adjustable relative to one (the second) of the crystal electrodes to form therewith a variable condenser.

One form of holder in accordance with the present invention is shown by way of example in Figures 1 and 2 of the accompanying drawing in which Figure 1 is a central vertical section through the holder and Figure 2 is an exploded view in perspective of the holder. Figures 3 and 4 are circuit diagrams of electrical filter networks employing piezoelectric crystals and illustrate how a holder in accordance with this invention may be utilized.

Referring now to Figures 1 and 2, the holder comprises three plates 11, 12 and 13 of insulating material which are secured together by screws 14 passing through aligned holes in the end plate 11 and the centre plate 12 and screwing into tapped holes in the other end plate 13. The centre plate 12 is provided with apertures 15 and 16 in which crystals 17 and 18 may be housed between a common electrode formed by a metal plate 19 located in a recess 19a in the end plate 13, and two separate electrodes formed by the metal plates 20 and 21 which are located in recesses 22 and 23 respectively formed in the insulating plate 11. The inner face of the end plate 11 is also formed with a deeper circular recess 24 which houses a movable semi-circular plate electrode 25 which is spaced from the electrodes 20 and 21 and is secured to a spindle 26 rotatably mounted in a bearing formed in the end plate 11. The spindle 26 projects beyond the outer surface of the end plate 11 and is provided with means, e. g. the slot 27, whereby the position of the semi-circular plate electrode 25 may be adjusted. The spindle 26 is also provided with an extension 28 which passes between the electrodes 20 and 21, through an aperture 29 in the plate 12 and through an aperture 30 in the electrode 19. A nut 31 screwed on the extension 28 of the spindle 26 holds a spring washer 32 in contact with the underside of the electrode 19 serving to provide an electrical connection between the movable electrode 25 and the electrode 19. As shown, the insulating plate 13 is formed with a recess 31a which receives the end of the spindle extension 28 with its attached nut 31 and spring washer 32. In some cases where it is not desired to connect electrically the electrode 19 with the movable electrode 25 the spindle extension 28 with the nut 31 and spring washer 32 may be omitted. The electrodes 20 and 21 are each provided with laterally extending tags 33 which extend beyond the edge of the insulating plates to provide convenient means whereby electrical connection may be made with the electrodes. The electrode 19 is similarly provided with a tag 34 projecting beyond the edge of the plates.

In operation, on rotation of the spindle 26, it will be seen that the rotating plate electrode 25 may be brought from a position in which it overlaps the electrode 20 only, through positions in which it overlaps decreasing areas of the electrode 20 and increasing areas of the other electrode 21, to a position in which it overlaps only this other electrode.

The invention accordingly provides a holder for piezoelectric crystals combined with a differential condenser. Such an arrangement may be used advantageously in electrical filter networks such for example as are shown in Figures 3 and 4. Figure 3 shows a network in which a single crystal is employed. In this arrangement it is usually desired either to balance out the capacity of the crystal 35 and its holder by means of the variable condenser 36 or to arrange for a so called "rejector point" in the transfer characteristic by adjusting the condenser 36 to

unbalance the circuit slightly. The above described holder may be used for this purpose by inserting a suitable crystal in one of the apertures, say aperture 15, in the insulating plate 12, connecting the tag 33 of electrode 20 with the end 37 of the inductance 38, connecting tag 33 of the electrode 21 with the other end 40 of the inductance 38, and connecting tag 34 of the electrode 19 with the output terminal 39. The circuit of Figure 4 shows a filter network employing a pair of crystals 40 and 41. In this case the tags 33 of electrodes 20 and 21 are connected with the ends 37 and 40 respectively of the inductance coil 38 and the tag 34 of electrode 19 is connected with the output terminal 39. Adjustment of the position of the movable electrode 25 relative to the fixed electrodes 20 and 21 enables any desired value of capacity within the limits of the dimensions of the apparatus to be connected in effect across one or other of the two crystals 40 and 41.

In some crystal filter circuits of the kind shown generally in Figure 4, the single crystals 40 and 41 may be replaced each by a plurality of crystals having different resonant frequencies, and it will be understood that wherever reference is made herein to a crystal, the use of either one or a plurality of crystals is contemplated. The holder of the present invention may be modified for such arrangements by providing in the insulating plate 12 a plurality of apertures arranged in two groups, one group of apertures being closed by the electrode 20 and the electrode 19 and the other group being closed by the electrode 21 and the electrode 19.

It will be seen therefore that the combined multiple crystal holder and condenser in accordance with this invention may be employed with advantage through saving in space and improved performance in piezoelectrical crystal band-pass filters and other circuits employing one or more piezoelectric crystals in which it is desired to control the performance by means of an adjustable condenser.

I claim:

1. In combination a piezoelectric crystal holder for accommodating two crystals comprising two independent pairs of electrodes, one pair for each crystal, and a differential condenser comprising a single rotor and two opposed stators, the said stators being constituted by one electrode of each of the said two pairs of electrodes.

2. In a piezoelectric crystal holder for accommodating two crystals, two coplanar electrodes associated one with each crystal and a third electrode mounted adjacent to the said two coplanar electrodes and adjustable relatively thereto.

3. In a piezoelectric crystal holder for accommodating two crystals, two coplanar electrodes associated one with each crystal and a third electrode rotatably mounted adjacent to and parallel with said two coplanar electrodes.

4. A piezoelectric crystal holder for accommodating two crystals comprising an insulating plate like member formed with two crystal locating apertures, two spaced coplanar electrodes mounted on one side of the said plate and covering the apertures therein, a single electrode mounted on the other side of said plate covering both said apertures, and an additional electrode mounted adjacent the said two coplanar electrodes and movable therebetween, the said additional electrode being electrically connected with the said single electrode.

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