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METHOD OF GRINDING PIEZOELECTRIC CRYSTALS

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Fig. 1

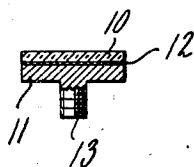


Fig. 2

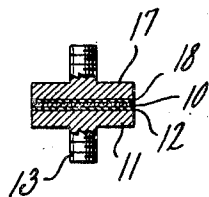
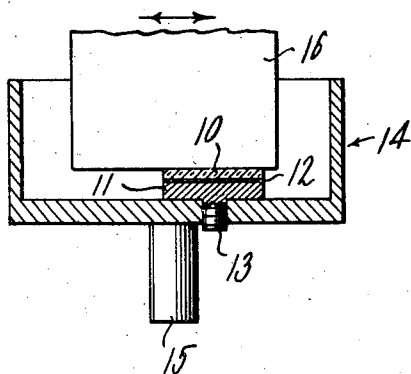


Fig. 3

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METHOD OF GRINDING PIEZOELECTRIC CRYSTALS

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5 Claims. (Cl. 171-327)

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This invention relates to electronic frequency stabilization devices and more particularly to piezoelectric crystals which are used in electronic apparatus to provide a frequency source of high stability.

The natural frequency of quartz crystals increases as the thickness of the crystal decreases and it is conventional practice to accomplish this reduction of thickness by grinding or other means. As the present trend is to explore and utilize higher and higher frequencies and to confine users strictly to the frequencies allocated to them, wide use is being made of crystals and extreme care is exercised in grinding them to the highest practical frequencies. This involves grinding or otherwise treating them until they are reduced to that degree of thinness where they can be handled without danger of fracturing them. It should be noted that after crystals are ground, they are cleaned, they may be etched, and they are thereafter mounted in crystal holders. The necessity for thus handling these highly fragile crystals imposes a practical limit on the highest frequencies to which they may be ground with safety.

Bearing the foregoing in mind, it is the object of the present invention to provide an apparatus and method of treating crystals wherein they may be ground to extremely high frequencies while minimizing the danger of fracture which this practice involves.

Another object of this invention is to provide a method of handling quartz crystals with safety and economy throughout the processing thereof.

Another object of my invention is to provide an improved method of testing the ground crystal during the grinding process to ascertain whether the desired frequency has been reached.

Other objects of my invention will be apparent from the following description it being understood that the above general statements of the objects of my invention are intended to describe and not to limit it in any manner.

Referring to the drawing:

Fig. 1 is an elevational view principally in cross-section illustrating a crystal preliminarily mounted according to the improved process.

Fig. 2 is a similar view illustrating the grinding thereof to reduce its natural frequency.

Fig. 3 is a similar view illustrating the mounting of the ground crystal.

The crystal 10, as shown in Fig. 1 has been cut and may have been only slightly ground to remove any irregularities. Its thickness is, therefore, many times that required and it may be

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handled easily and with safety. As an example, its natural frequency may be anywhere from 50 kilocycles to a few megacycles. In the conventional method, the practice at this point is to commence the grinding of the crystal. However, the first step in the improved process is to secure the unground or slightly ground crystal 10 to the holder 11, which may be of metal or metal plated glass or plastic. A practical method of doing this is to silver plate one side of the crystal in the known manner and, thereafter, to sweat the plated crystal onto the metal or metal plated holder 11 by applying a thin film of solder to each element and placing them in an oven. However, many other methods may be employed as for example, sputtering instead of silver plating or hot metal spraying.

Thus, the initial steps furnish the combination of the unground and therefore thick crystal 10 permanently connected by solder 12 to the holder 11 which is formed with the threaded shank 13.

This preliminary assembly is then screwed into the grinding chamber 14, the essential action of which is well known in the art. Briefly, the crystal is located slightly eccentrically in respect to the shaft 15 of the grinding chamber and the rotation of the shaft 15 causes the crystal to revolve in respect thereto. Simultaneously, the grinding member 16 reciprocates back and forth so that continuously varying surfaces of the free side of the crystal are subjected to its action. A suitable grinding paste is applied between the crystal and the grinding plunger in the conventional manner. The crystal is tested at intervals to determine its progress toward the frequency desired. The grinding action continues until the crystal has been ground to this frequency.

At this point, if the conventional method had been employed, the operator would now be confronted with the critical problem of mounting the extremely thin crystal.

It can be seen however, that this improved method of grinding the crystal in situ, while simple, automatically eliminated this most troublesome problem in handling thin crystals. In other words, when it has been brought down to the degree of thinness required, the mounting thereof is automatically substantially accomplished and the danger of fracture is hardly more, or possibly less, than that of thick crystals. It may be considered that the soldered holder makes the crystal more resistant to fracture through handling than is a crystal many times its thickness.

It has been found that it is possible to thus grind crystals to a thinness hitherto considered

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impractical. It also follows that the percentage of fractured crystals ground to conventional frequencies is much less when the instant method is employed.

The improved method described herein presents a further advantage in that the frequent testing of the crystal during the grinding process is effected while the crystal is mounted in the holder 11. It is well known that the frequency of a crystal when mounted usually differs from the same crystal unmounted so that the operator is presented with an additional problem in achieving the exact frequency required. However, in the instant case, the difficulty, while not entirely removed, is considerably alleviated since the crystal is disposed, to a considerable extent, in the environment of its ultimate disposition.

The final steps in the process are illustrated in Fig. 3. After the crystal 10 has been ground or otherwise brought to the desired frequency, an opposing holder 17 is secured as by solder 18 to the unmounted side of the crystal which may have been silver plated as was the side initially mounted. The completed assembly makes a convenient structure for final mounting preparatory to actual use and the extremely thin crystal is obviously in very slight danger of injury through subsequent handling.

I have shown a preferred embodiment of my invention but it is obvious that many changes and omissions may be made without departing from its spirit.

I claim:

1. A method of processing piezoelectric elements which comprises permanently securing one side of said element to a support and thereafter reducing the thickness of said element by removing material from the free side thereof so as to increase its natural frequency.

2. A method of processing a piezoelectric ele-

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ment which comprises securing one side of said element to a support by a metallic bond and thereafter reducing the thickness of said element by removing material from the free side thereof so as to increase its natural frequency.

3. A method of processing a piezoelectric element which comprises permanently securing one side of said element to a support, securing said support in a grinding chamber, and grinding the free side of said element so as to increase the natural frequency thereof.

4. A method of processing a piezoelectric crystal which comprises plating one side thereof with metal, securing said plated side to a support by a metallic bond, securing said support in a grinding chamber and grinding the free side of said crystal so as to increase its natural frequency.

5. A method of processing a piezoelectric crystal which comprises permanently securing one side of said crystal to a support by a metallic bond, securing said support in a grinding chamber, grinding the free side of said crystal so as to bring the natural frequency thereof up the desired point, and thereafter securing an opposing support to said ground side of said crystal.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
282,049	Campbell	July 31, 1883
1,619,125	Hough	Mar. 1, 1927
2,310,612	Bremer et al.	Feb. 9, 1943

FOREIGN PATENTS

Number	Country	Date
445,046	Germany	May 30, 1927