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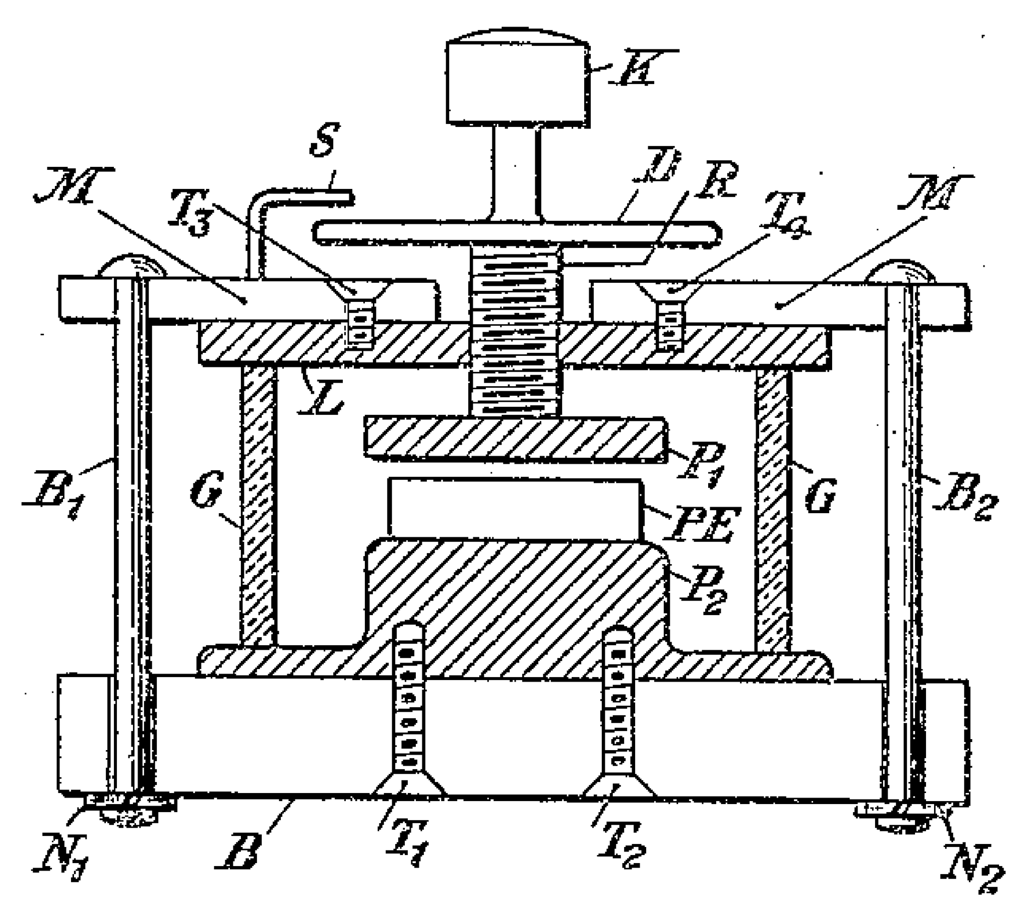

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MOUNTING FOR PIEZO-ELECTRIC DEVICES

Application filed September 23, 1926. Serial No. 137,376.

This invention relates to mountings for piezo-electric crystals or devices, and particularly to arrangements in such mountings for avoiding or greatly reducing the undesirable effects on the free vibratory period of the piezo-electric member caused by variations in the surrounding thermal conditions.

A piezo-electric device comprises a crystal of piezo-electric character which may be set into vibration between two conductive electrodes. When such a piezo-electric crystal is placed between the two conductive electrodes in such a way that a gap exists between one or two of the surfaces of the piezo-electric crystal and the adjacent conductive electrodes, so that the piezo-electric crystal may freely vibrate therebetween, the vibratory period of the piezo-electric crystal may be varied by changing the size of the gap between the piezo-electric crystal and the adjacent conductive electrodes. In experimenting with such a crystal it has been found that as the size of the gap changed, the frequency of vibration of the piezo-electric crystal also changed within reasonable limits.

Heretofore, such a piezo-electric crystal was mounted between two metallic plates or electrodes in some suitable form of mounting in such a way that the gap above-mentioned was provided to permit the free vibration of the piezo-electric crystal. The size of the gap was found to be dependent upon the rigidity of certain insulating material, such as hard rubber, bakelite, etc., used for the base of the mounting. Moreover, in the mountings heretofore used for piezo-electric devices, the external thermal variations brought about expansions and contractions of the elements of the mounting, causing uncontrollable changes in the size of the gap existing between the piezo-electric crystal and its adjacent conductive plates or electrodes. Due to such changes in the external thermal conditions, the piezo-electric crystal continually assumed a different vibratory period.

One of the principal objects of this invention is the provision of means in such forms of mountings for piezo-electric devices wherein the undesirable effects of temperature variation on the free vibratory period of a piezo-electric crystal contained therein are avoided or substantially reduced.

Another of the objects of this invention is the provision of means for adjusting the size of the gap existing between the conductive electrodes and the piezo-electric crystal therebetween so that the vibratory period of the piezo-electric device may be changed as conditions necessitate, said adjustments being independent of external temperature variations.

In my copending application, Serial No. 137,377, filed September 23, 1926, I have shown, described and claimed a piezo-electric crystal mounting having a pair of electrodes spaced by a definite distance and the spacing of these electrodes is maintained substantially constant and invariable even during external temperature variations.

While this invention will be pointed out with particularity in the appended claims, the invention itself, both as to its further objects and features, will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing, showing a cross-sectional view of a mounting for a piezo-electric device and the enclosed piezo-electric device, which drawing is shown herein merely for the purpose of illustration.

Referring to the drawing, there are shown two conductive electrodes P_1 and P_2, these electrodes forming the means for the transmission or reception of electric current to or from a piezo-electric device PE, mounted between these electrodes. It will be understood that these electrodes P_1 and P_2 may be of any material whatsoever, but that they are preferably of some conductive material such as brass, steel, nickel, etc. The device of piezo-electric character, PE, is so placed between the conductive electrodes P_1 and P_2 that a gap exists between one or both of the surfaces of the piezo-electric device PE and the adjacent conductive electrodes P_1 and P_2. This gap permits the free vibration of the piezo-electric device at a characteristic frequency. Yet by changing the size of this gap the vibratory period of the piezo-electric device PE may be changed as conditions necessitate, as will be shown more fully in the description hereinafter following.

The conductive electrode P_2 is suitably fastened to a base B by means of two screws T_1 and T_2. This base B may be of any material whatsoever, but it is preferably of some insulating material, such as hard rubber, bakelite, porcelain, glass, etc. A tube or cylinder G surrounds the piezo-electric device PE and is preferably coaxial therewith. This tube or cylinder G separates the conductive electrodes P_2 from a metallic plate L by a predetermined distance. The tube or cylinder G may be of any material, but it is preferably of some such insulating material as glass, porcelain, etc. The conductive electrode P_1 is permanently fastened to a threaded shaft R, which shaft R may be revolved in a threaded groove provided in the center of the metallic plate L. The upper end of the threaded shaft R is permanently fastened to a dial D and a knob K. When the knob K is revolved in one direction the conductive electrode P_1 moves upwardly, and when the knob K is revolved in the other direction the conductive electrode moves downwardly. Accordingly, the size of the gap between the conductive electrodes P_1 and P_2 and the piezo-electric member PE placed therebetween may be adjusted as conditions necessitate. Permanently fastened to the metallic plate L is another base M, the fastening comprising, for the purpose of illustration, two screws T_3 and T_4. An indicator S is mounted on the base M and is so placed with respect to the dial D that as the dial moves in one direction or in the other the size of the gap may be varied and a suitable indication provided by means of the indicator S which cooperates with the dial D to readily determine the size of the gap.

The thickness and general lateral proportions of the tube or cylinder G are of such magnitude that the capacity between the electrodes P_1 and P_2, due to the presence of this tube or cylinder, is substantially negligible when compared with the capacity between the electrodes P_1 and P_2 through the piezo-electric device PE and the gap between this device and the electrodes P_1 and P_2. The length and general longitudinal dimensions of the tube or cylinder G are so proportioned with respect to the longitudinal proportions of the conductive electrodes P_1 and P_2, and the linear coefficients of thermal expansion of the tube or cylinder G and of the conductive electrodes P_1 and P_2 are so chosen, that any change in the longitudinal dimensions of the conductive electrodes P_1 and P_2 due to any variation in the external thermal conditions, will be equal and opposite to the change taking place in the longitudinal dimensions of the tube or cylinder G due to the same external temperature variation. After the size of the gap between the conductive electrodes and the piezo-electric device PE therebetween has been carefully adjusted, there will be substantially no variation in the size of this gap due to variations in the external thermal conditions.

As the external temperature rises, the distance between the conductive electrodes P_1 and P_2 will decrease, and vice versa. Furthermore, as the external temperature rises, the longitudinal dimension of the tube or cylinder G will increase, and vice versa. The general physical proportions of the tube or cylinder G and of the conductive electrodes P_1 and P_2 are so chosen that the products of any changes in their longitudinal dimensions and their corresponding linear coefficients of thermal expansion will be substantially equal. Yet it will be noted that these products may be varied so as to bear some fixed relationship to each other to bring about any change in the size of the gap between the piezo-electric device PE and the adjacent conductive electrodes, when a change takes place in the external thermal conditions, all of which is within the scope of this invention.

It will therefore be clear that this invention is designed to provide a mounting for a piezo-electric device in which the frequency characteristic of the piezo-electric device may be varied as conditions necessitate, substantially free from variations in the external thermal conditions. Such a mounting is particularly desirable where the frequency characteristic of the piezo-electric device must be brought into synchronism with the frequency characteristic in some other electrical circuit.

While this invention has been shown and described in one embodiment merely for the purpose of illustration, it will be understood that the general principles of this invention may be embodied in other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A mounting for a piezo-electric device, having means associated therewith for varying the vibratory period of said piezo-electric device as desired, said means being substantially unaffected by external temperature variations.

2. A mounting for a piezo-electric device, comprising two conductive electrodes between which a piezo-electric device may be placed so that it may freely vibrate therebetween, means for adjusting the distance between said conductive electrodes, and means for maintaining the distance between said electrodes substantially independent of external temperature variations.

3. Piezo-electric apparatus including a piezo-electric device, two electrodes between which the piezo-electric device may be placed, a gap being provided between the piezo-elec-

tric device and one of the conductive electrodes so that said piezo-electric device may freely vibrate between said electrodes, means for varying the size of said gap in order to correspondingly vary the vibratory period of said piezo-electric device, and means for rendering the size of said gap substantially independent of external temperature variations.

4. Piezo-electric apparatus including a piezo-electric device, two conductive electrodes between which the piezo-electric device may be placed, a gap being provided between the piezo-electric device and one of the conductive electrodes so that said piezo-electric device may freely vibrate between said electrodes, means for varying the size of the gap existing between the piezo-electric device and the conductive electrodes, means for rendering the size of the gap substantially independent of external temperature variations, and means for determining and indicating the size of said gap.

5. Piezo-electric apparatus including a piezo-electric device, two metallic electrodes having faces disposed so that the piezo-electric device may freely vibrate therebetween and so that there may be a longitudinal movement of these faces due to external temperature variations, a tube surrounding the piezo-electric device and co-axial therewith, said tube being made of an insulating material having a predetermined linear coefficient of thermal expansion and producing a longitudinal movement due to said external temperature variations equal and opposite to that of the faces of said metallic electrodes, and means for changing the effective distance between the faces of said metallic electrodes substantially independently of external temperature variations.

6. Piezo-electric apparatus including a piezo-electric device, two metallic electrodes having faces disposed so that the piezo-electric device may freely vibrate therebetween, a cylinder coaxial with the piezo-electric device and separating the faces of the metallic electrodes by a predetermined distance, said cylinder being formed of a material having a predetermined linear coefficient of thermal expansion, any external temperature variation producing a linear movement of the faces of the metallic electrodes substantially equal and opposite to the linear movement of the cylinder separating the faces of the metallic electrodes, and means for changing the effective distance between the faces of said metallic electrodes independently of said external temperature variations.

7. A mounting for a piezo-electric device, comprising a pair of metallic electrodes, a piezo-electric device included between said metallic electrodes so that a gap exists between the piezo-electric device and surfaces of the metallic electrodes, the piezo-electric device assuming a characteristic frequency and freely vibrating at that characteristic frequency, a tube having a predetermined linear coefficient of thermal expansion surrounding the metallic electrodes and the piezo-electric device, said tube effecting a linear movement of the metallic electrodes equal and opposite to the linear movement of said electrodes during any change in the external temperature conditions, and means for changing the size of the gap between the metallic electrodes and the piezo-electric device independently of said external temperature variations.

8. The combination of a pair of metallic electrodes, a piezo-electric device located between the electrodes, a gap being provided between the metallic electrodes and the piezo-electric device, a hollow cylindrical body coaxial with said metallic electrodes and having a coefficient of expansion such as to counteract the linear displacement of said metallic electrodes caused by external temperature variations, and means for varying the size of said gap substantially unaffected by said external temperature variations.

9. A mounting for piezo-electric bodies, comprising two conductive electrodes, means for varying the distance between said electrodes, and means for maintaining the distance between said electrodes independent of variations in the condition of the surrounding medium.

In testimony whereof, I have signed my name to this specification this 21st day of September, 1926.

RUSSELL S. OHL.