June 3, 1947. R. W. TIBBETTS 2,421,586

PIEZOELECTRIC DEVICE

Filed Sept. 20, 1944

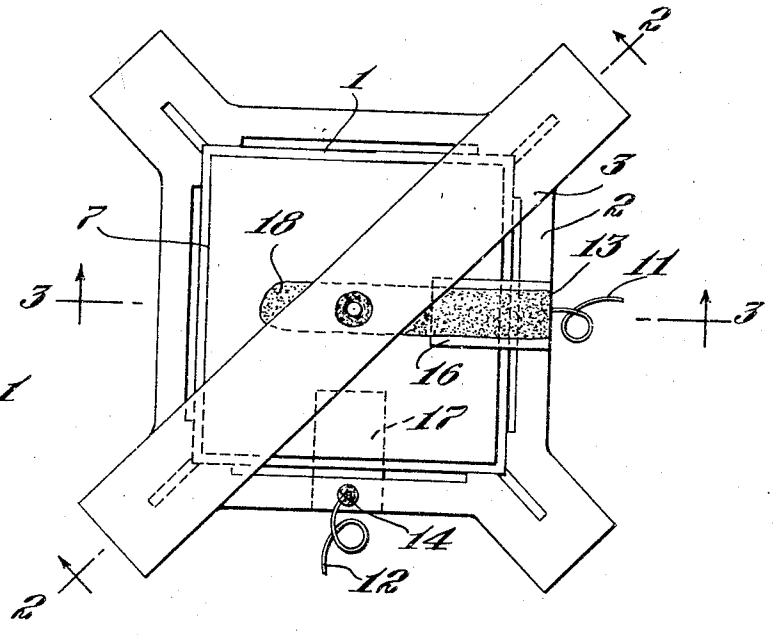


Fig. 1

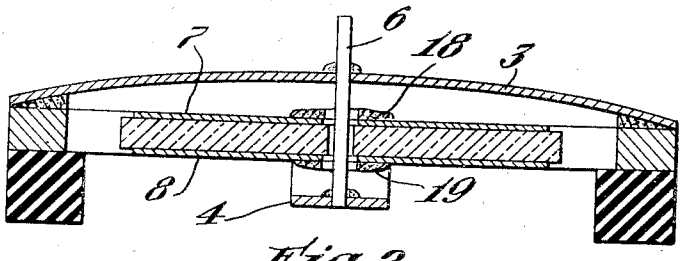


Fig. 2

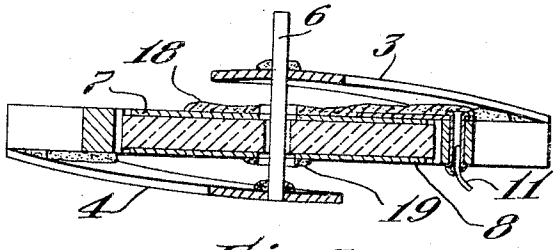


Fig. 3

Inventor
Raymond W. Tibbetts
by Roberts, Cushman & Grover
Attys.

Patented June 3, 1947

2,421,586

UNITED STATES PATENT OFFICE

2,421,586

PIEZOELECTRIC DEVICE

Raymond W. Tibbetts, Camden, Maine, assignor to Tibbetts Laboratories, Inc., Camden, Maine, a corporation of Maine

Application September 20, 1944, Serial No. 554,915

7 Claims. (Cl. 171—327)

1

This invention relates to piezo-electric devices for converting electrical energy into mechanical vibrations or converting mechanical energy into electrical impulses, and more particularly to means for conducting current to the piezo-electric slab from an external circuit or from the piezo-electric slab to an external circuit. While the invention is applicable to the ordinary piezo-electric device of the type comprising two layers cemented together with their axes extending in different directions, so that when one layer contracts in one direction the other layer expands in the same direction at the same time to cause the slab to warp, the invention is particularly applicable to piezo-electric devices of the type disclosed in my prior Patent No. 2,386,279, granted October 9, 1945, which requires only one layer and, if there be more than one layer, the axes of all the layers extend in the same direction. Instead of warping, the device expands and contracts diagonally, alternately expanding and contracting along each diagonal.

According to the present invention the device comprises a piezo-electric slab with a frame extending along its periphery for supporting the slab, together with means for passing current between the slab and an external circuit, the means including an eyelet or other anchor attached to the frame and a layer of conducting material extending from the anchor over one face of the slab. Preferably the anchor is in the form of an eyelet extending through the frame and the conducting material is a coating of colloidal or partially colloidal graphite or other suspension of conducting material, such as colloidal gold, or a sprayed metal product. While the conducting material may be applied directly to the faces of the piezo-electric slab, preferably the slab is first coated with gold leaf as disclosed in my Patent No. 2,287,950, the leads for conducting the current being applied over these layers and being anchored to the frame as aforesaid. In the preferred form of the invention a sheet of metal foil or the like is applied to the face of the slab with a portion overlapping the frame, and the aforesaid coating of graphite or the like is applied over the sheet, this construction being particularly desirable when the lead has to bridge a gap between the edge of the slab and the frame.

In another aspect the device comprises a toggle extending along one side of the slab in the direction in which the slab expands and contracts, together with bearing means fast to the ends of the toggle and bearing on opposite edges of the slab so that expansion of the slab in the aforesaid direction tends to straighten the toggle, the aforesaid anchor for the conducting lead being attached to said bearing means and the aforesaid frame preferably comprising the bearing means. The construction of the frame and toggles and the mode of operation is fully described in the aforesaid application.

2

For the purpose of illustration a typical embodiment of the invention is shown in the accompanying drawings in which

Fig. 1 is a plan view of the device;

Fig. 2 is a section on line 2—2 of Fig. 1; and

Fig. 3 is a section on line 3—3 of Fig. 1.

The particular embodiment of the invention chosen for the purpose of illustration resembles that disclosed in the aforesaid application in that it comprises a piezo-electric slab 1 mounted in a frame 2 which engages the edges of the slab only at the corners, the slab being cut from the original crystal so that it expands alternately, in response to alternating current, along its two diagonals. Extending along one diagonal on one side of the frame is a toggle 3 and extending along the other diagonal along the other side of the device is a toggle 4, each toggle being in the form of a bow arched away from the slab in the middle and having its ends cemented or otherwise secured to the corners of the frame. The two toggles 3 and 4 are interconnected by a rod 6 which may be connected to a microphone, speaker or the like depending upon the use to which the device is to be put. The faces of the slab 1 are covered with layers 7 and 8 of conducting material which is preferably gold leaf. Conductors 11 and 12 are connected to the conducting layers 7 and 8 for transmitting current to or from the device. While the frame is preferably formed of Bakelite or other insulating material, it may be formed of conducting material insulated from the slab and eyelets.

As fully described in the aforesaid Patent No. 2,386,279 the slab expands along one diagonal when current flows through the slab in one direction and it expands along the other diagonal when current flows in the opposite direction. When the slab expands along one diagonal it contracts along the other diagonal. Consequently when the slab expands in the direction of the bow 3 the bow straightens and the bow 4 arches farther away from the slab. Thus both bows tend to move the rod 6 downwardly (Figs. 2 and 3). Conversely when the slab expands in the direction of the bow 4 both bows tend to move the rod 6 upwardly.

In accordance with the present invention eye-

lets 13 and 14 are riveted through two sides of the frame for attachment to the conductors 11 and 12. Two sheets 16 and 17 of silver foil or the like are cemented to the two faces with their outer ends overlapping the frame to and preferably under the heads of the eyelets 13 and 14. The aforesaid coating of graphite is then applied over the faces of the slab and sheets and over the heads of the eyelets, as indicated at 18 and 19. While these graphite coatings may extend over the entire faces of the slab, it is usually sufficient to have them extend only throughout a small part of the faces of the slab as indicated in the drawings.

From the foregoing it will be understood that current flows through the conductor 11 to the eyelet 13, thence through the foil 16 and coating 18, thence through the gold leaf electrode 7, thence through the slab and thence through the electrode 8, coating 19, foil 17, eyelet 14 and conductor 12. By virtue of the eyelets 13 and 14 which may anchor the outer ends of the leaves to the frame, the leaves do not tend to pull loose or break off in use.

As disclosed in the aforesaid application the entire device may be covered with a moisture-proof coating such as cellulose nitrate, polystyrene, a Vinylite plastic dissolved in a suitable solvent, etc., the solution being sprayed on or otherwise applied in layers, each layer being dried before the next layer is applied.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which wall within the scope of the appended claims.

I claim:

1. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, a sheet extending along one side of the slab and overlapping the frame, and means for passing current between the slab and an external circuit, said means including an anchor attached to said frame and a layer of conducting material extending from the anchor over said sheet and over one face of the slab.

2. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, thin conducting layers mounted on opposite faces of the slab for conducting current to and from the slab, a sheet extending along one side of the slab and overlapping the frame, and leads for connecting said layers to an external circuit, each lead having a portion in contact with one of said layers and a portion anchored on said frame and an intermediate portion extending over said sheet.

3. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, a sheet of metal foil attached to one face of the slab and overlapping the frame, and means for passing current between the slab and an external circuit, said means including an anchor attached to said frame and a layer of conducting material extending from the anchor over said sheet.

4. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, thin conducting layers mounted on opposite faces of the slab for conducting current to and from the slab, a sheet of metal foil attached to one face of the slab and overlapping the frame, and leads for connecting said layers to an external circuit, each lead having a portion in contact with one of said layers and a portion anchored on said frame and an intermediate portion extending over said sheet.

5. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, a sheet extending along one side of the slab and overlapping the frame, and means for passing current between the slab and an external circuit, said means including a layer of conducting material fast to the frame and extending over said sheet and over one face of the slab.

6. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, a sheet extending along one side of the slab and overlapping the frame, and means for passing current between the slab and an external circuit, said means including a coating of conducting material extending over said sheet with its opposite ends fast to the frame and slab respectively.

7. In a device of the character described the combination of a piezo-electric slab, a frame extending along the periphery of the slab for supporting the slab, a sheet extending along one side of the slab and overlapping the frame, and means for passing current between the slab and an external circuit, said means including a layer of conducting material extending over said sheet with its opposite ends adhering to the frame and slab respectively.

RAYMOND W. TIBBETTS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,081,862	Williams	May 25, 1937
2,386,279	Tibbetts	Oct. 9, 1945
2,155,035	Bieling	Apr. 18, 1939
2,168,809	Semple	Aug. 8, 1939