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PIEZOELECTRIC DEVICE

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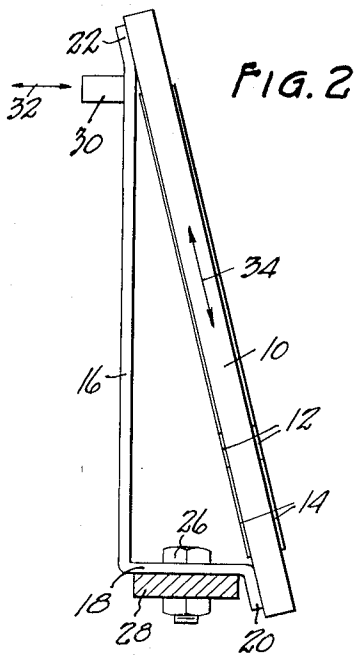


FIG. 2

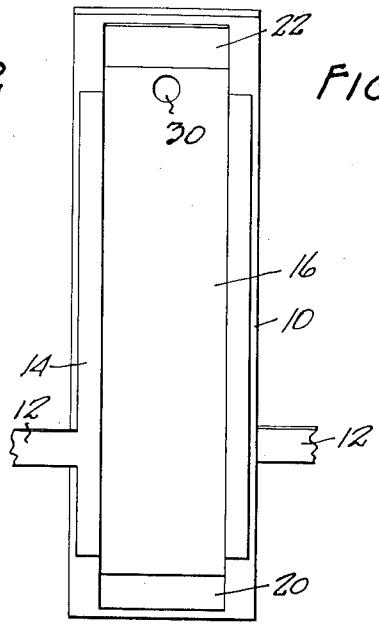


FIG. 1

FIG. 3

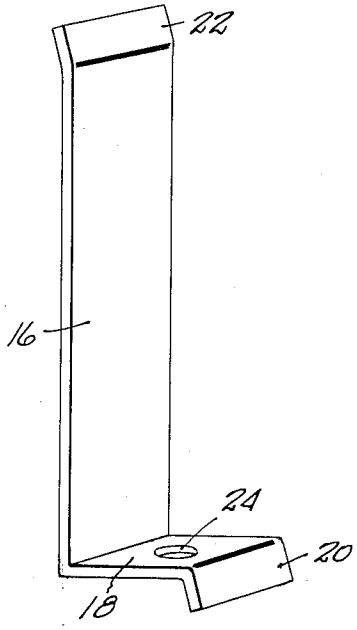
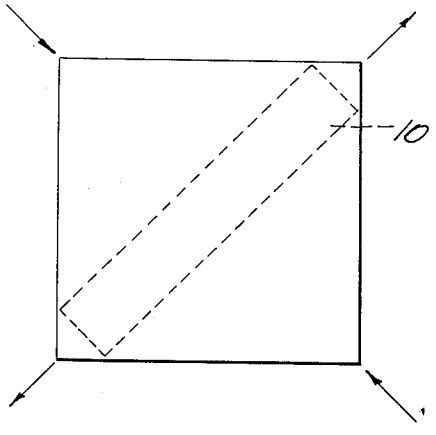


FIG. 4



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PIEZOELECTRIC DEVICE

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5 Claims. (Cl. 310—8.5)

This invention relates to improvements in piezo-electric devices, and more particularly to a piezoelectric device adapted for use in transmitting mechanical vibrations into electric energy and vice versa. Devices of this character are commonly used for phonograph pick-ups, phonograph record cutters and microphones, and the instant invention may be used in all of these fields with high efficiency.

The primary object of the invention is to provide a novel, simple and inexpensive device operable to actuate a single slab or element type of piezoelectric device for the purpose of generating an electrical potential.

A further object is to provide a device of this character wherein a piezoelectric member or slab of the expander bar type, which is adapted to generate a voltage when expanded or contracted in its plane, has attached thereto a harness of simple construction for effecting expansion and contraction thereof.

A further object is to provide a device of this character wherein a piezoelectric element of the expander bar type is mounted upon a harness having two angularly disposed parts connected to opposite ends of said element, one of said parts being fixedly anchored to a support, and the remote end of the other part having associated therewith a vibration responsive member to cause oscillation of said harness part laterally in a manner to vary the spacing between the points of connection of the harness with the piezoelectric element and thereby to lengthen and shorten said element responsive to vibration.

Other objects will be apparent from the following specification.

In the drawing:

Fig. 1 is a face view of the piezoelectric device.

Fig. 2 is a side view of the device.

Fig. 3 is a perspective view of the harness construction.

Fig. 4 is a view illustrating the manner in which an expander bar piezoelectric member is shaped.

Referring to the drawing which illustrates the preferred embodiment of the invention, the numeral **10** designates a piezoelectric element of the single slab type. The element will preferably be of the Rochelle salt crystal type. The Rochelle salt crystal, which is of the X-cut type, will generate a voltage or electrical potential if stretched across one diagonal thereof and compressed across the other diagonal thereof, as illustrated in Fig. 4. Such an X-cut crystal may have cut therefrom a slab **10**, as illustrated in dotted lines in Fig. 4, along a diagonal, said crystal slab preferably being long and narrow, as seen in Fig. 1. Consequently, it will be apparent that, when such a piezoelectric element is either lengthened or shortened in its plane, it will generate an electrical potential or voltage. This voltage is transmitted by the lead elements **12** which project from electrodes **14** adhered to opposite faces of the piezoelectric element.

The piezoelectric element is mounted upon a harness of the character best illustrated in Fig. 3. This harness is particularly referred to as a bridge structure or backing plate and is commonly formed from sheet metal having a substantial degree of rigidity and being capable normally of maintaining its shape. As best illustrated in Fig. 3, the backing member comprises a long, substantially flat plate portion or leg **16**, and a comparatively short leg portion **18** disposed angularly thereto and preferably at approximately right angles to the portion **16**. A narrow flange portion **20** projects angularly from the leg portion **18**, and a lip portion **22** projects from the free end of the leg **16**. The piezoelectric element is cemented or adhered or otherwise fixedly secured at its opposite end portions at one face thereof to the flange and lip portions **20** and **22** by the use of any cement or bonding material found suitable. The length of the piezoelectric element will be substantially the same as the overall length or spacing of the outer edges of the flanges **20**, **22**.

The leg **18** will preferably be provided with one or more apertures **24** adapted to receive a securing member **26**, such as a bolt, rivet or the like, passing through the aperture **24** and also through a rigid supporting member **28**. The entire piezoelectric device is supported from the member **28**, and the parts will preferably be so arranged that the piezoelectric element **10** will be positioned laterally of and clear of the support **28**. The harness will be provided at a point remote from the portion **18**, as at the free end of the portion **16** or at the portion **22**, with a member, illustrated diagrammatically as **30** in Fig. 2, which is adapted to be connected to a vibratory member. In the case of a microphone, the member **30** will be connected to a diaphragm (not shown) to cause the vibration of the diaphragm to be transmitted by the member **30** and to effect an oscillation of the harness structure **16**, **18** substantially perpendicular to the plane of the part **16**. In the case of a phonograph pick-up the part **18** will constitute means for connection with or for mounting a phonograph needle or stylus, and similarly will be arranged so that vibrations caused during the operation of the phonograph are transmitted to the harness of the piezoelectric structure to oscillate the same in a plane transverse of the plate portion **18**.

The application of vibratory motion to the piezoelectric element in this particular manner is such that the harness or structure tends to hinge or pivot along the line of bend between the parts **16** and **18**. It will be apparent that, as this action occurs, the spacing between the free ends of the harness structure **20**, **22** will be varied. In other words, as the angular displacement of the parts **16** and **18** changes, then there is caused a difference in the spacing of the diagonal connecting the ends of those parts. This action produces an alternate lengthening and shortening or expansion and contraction of the piezoelectric element in a manner to cause the same to generate an electrical potential. In other words, when forces are applied in the direction of the arrow **32** to the free end of the harness, the dimensions of the harness are changed, and these changes in dimensions cause a change of the dimensions of the piezoelectric element in its plane, as indicated by the arrows **34**.

The construction thus constitutes a very simple and effective piezoelectric device, reducing to light weight and small size the overall or assembled structure, holding the weight of the parts to a small mass. Additional advantages of the construction are simplicity of fabrication, limitation of the piezoelectric elements required to a single slab or unit, and reduction of the number of electrodes required. The device is also highly efficient for its intended purpose and possesses in full measure the response to vibration by the generation of a pulsating electrical current or voltage which is necessary in conjunction with transducers of different types.

While the device herein illustrated and described constitutes the preferred embodiment of the invention, it will be understood that changes may be made in the con-

struction described and illustrated within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. A piezoelectric device comprising a piezoelectric element of the type adapted to generate a voltage when stressed in its plane, a substantially L-shaped harness having its end portions fixedly secured to the end portions of said element, one part of said harness adjacent to one end of said element being anchored to a fixed support, and means associated with a part of said harness spaced from said support for transversely flexing said harness in a direction at an angle to the plane of said piezoelectric element.

2. A piezoelectric device as defined in claim 1, wherein the anchored portion of said harness is short compared to the length of the remaining portion of the harness.

3. A piezoelectric device comprising a bridge structure including a pair of angularly disposed portions of unequal length, means mounting the short portion of said structure upon a fixed support, means located at the outer end of said long portion for oscillating the long portion transversely, and a piezoelectric element of the expander bar type extending diagonally between and fixedly secured to the opposite ends of said structure whereby it expands and contracts in its plane and at an angle to the direction of oscillation of said oscillating means.

4. A piezoelectric device of the construction defined in claim 3, wherein said bridge structure constitutes an elongated metal plate bent substantially perpendicularly intermediate its ends to define said angular portions.

5. A piezoelectric device of the construction defined in claim 3, wherein said bridge structure includes terminal flange portions cemented to said element.

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