Aug. 23, 1932. A. MEISSNER 1,873,715

PIEZO ELECTRIC ACOUSTIC DEVICE

Filed July 26, 1928

Fig. 1

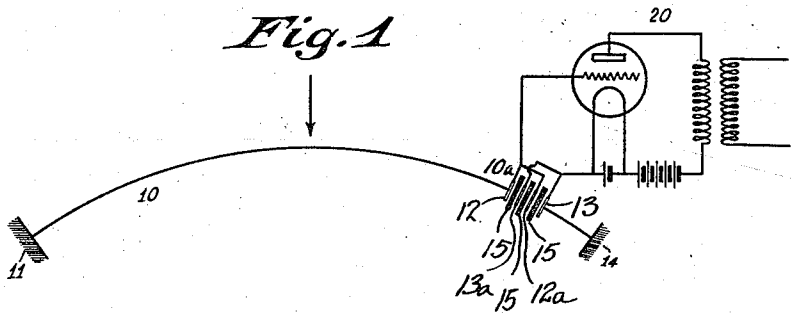


Fig. 2

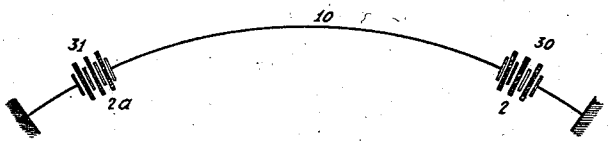
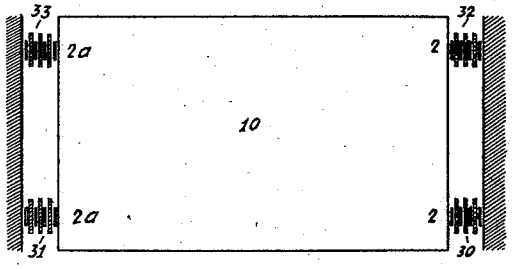


Fig. 3



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Patented Aug. 23, 1932 1,873,715

UNITED STATES PATENT OFFICE

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PIEZO-ELECTRIC ACOUSTIC DEVICE

Application filed July 26, 1928, Serial No. 295,491, and in Germany September 17, 1927.

This invention relates to the piezo electric art and deals more specifically with an acoustic device employing a piezo electric element. It has already been proposed in the prior art to utilize the piezo electric effect in connection with microphonic and telephonic apparatus. For example, if sound waves are brought to act upon a suitably arranged piezo electric body by the agency of a diaphragm, the pressure variations caused by the sound wave are directly converted into electrical oscillations, the electrical effects being proportional to the pressure brought to act upon the piezo electric body.

However, devices of this character involve a serious difficulty, that is, that the electrical actions are extremely feeble. It is therefore an object of this invention to provide an arrangement whereby the ensuing action can be considerably amplified.

Briefly, this object is attained by the use of a diaphragm in combination with a piezo electric body, the diaphragm being arched and arranged whereby the sound energy impinges upon said diaphragm and the motional changes produced thereby are converted into electrical impulses through the action of the piezo electric element. An arched diaphragm of this type produces amplified pressure forces in the direction of the surface, that is, tangentially whenever motional forces come to act upon its curved surface.

Curved or arched diaphragms per se are well known in the art, but the combination of such a curved diaphragm with a piezo electric device results in a particularly effective assembly for it is just a diaphragm thus shaped which is particularly adapted directly to transfer upon the piezo electric body such strong pressure forces as are capable to substantially increase the electrical action. Moreover, the resultant effects may be increased still further to a considerable degree by choosing a piezo electric device comprising a plurality of superimposed piezo electric elements, so that the pressure brought to act upon the pile of these piezo electric elements makes itself felt simultaneously on all of these bodies and accordingly by means of a suitable circuit arrangement the individual electrical effects of each crystal may be integrated in the external circuit.

The manner in which this invention is carried out will be more clearly understood from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a diagrammatic representation of a specific embodiment of this invention; and

Figs. 2 and 3 are diagrammatic views of modifications.

Referring in detail to Fig. 1, the arched diaphragm 10 is fixedly supported at 11 and the end 10*a* of the diaphragm has joined to it an electrode 12, the electrode 12 being adapted to move in accordance with the mechanical vibrations of the crystal. A second electrode 13 is fixedly joined to the support 14. Intermediate of the plates 12 and 13 are the piezo electric crystal elements 15 suitably cut to give the desired electrical and mechanical characteristics. Intermediate of the elements 15 are the auxiliary plates or electrodes 12*a* and 13*a*. The electrodes 12 and 12*a* are electrically connected and the electrodes 13 and 13*a* are electrically connected. A suitable amplifying device 20 is connected across the electrodes 12 and 13.

The operation of the device is as follows:

Sound impulses are made to impinge upon the diaphragm 10 and the motion of the vibrations produced thereby exerts a tangential force which is applied to the electrode 12 and from this electrode to the crystal elements mounted between the electrode 12 and the fixed electrode 13. The electrical oscillations resulting from the mechanical movement of the diaphragm are impressed upon the input circuit of the amplifier 20 and thus may be amplified as desired.

In accordance with the modification of Fig. 2 the diaphragm 10 is mounted between two crystal units 30 and 31 each of which is similar in structure to the crystal assembly shown in Fig. 1 and which is provided with a similar arrangement of intermediate plates. Each of the crystal units 30 and 31 are connected to either the same or separate amplifying units as may be desired. By virtue of

the use of the additional crystal assembly more efficient transformation from sound impulses to electrical oscillations may be realized.

In a modification shown in Fig. 3 diaphragm 10 is supported between four crystal assemblies or units indicated as 30, 31, 32 and 33. The elements 30 and 32 may be connected in parallel to an amplifier and the elements 31 and 33 may be connected in parallel to the same amplifier or to a separate amplifier as desired.

It will be understood, of course, that while the foregoing description relates to the operation of the present device as a microphone, that is, that sound waves impinging upon the diaphragm and being converted into electrical oscillations, this device may be used also in a reversible sense as a loudspeaker and electrical oscillations impressed upon the crystal units may be used to actuate the diaphragm to produce the necessary sound impulses. Many changes in the specific embodiments disclosed herein will readily suggest themselves to those skilled in the art and this invention therefore is not to be limited in scope except as defined in the appended claims.

Having thus described my invention, I claim:

1. An electroacoustic device comprising in combination, an arched vibratory diaphragm, a plurality of piezo-electric elements connected to opposite ends of said diaphragm, whereby mechanical vibrations applied to the surface of said arched diaphragm are converted into tangential stresses, which stresses are exerted upon said piezo-electric elements to produce piezo-electric reactions in accordance therewith.

2. An electroacoustic device comprising in combination, an arched vibratory diaphragm, a plurality of piezo-electric elements connected in parallel to opposite ends of said diaphragm, whereby mechanical vibrations applied to the surface of said arched diaphragm are converted into tangential stresses, which stresses are exerted upon said piezo-electric elements to produce piezo-electric reactions in accordance therewith.

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