Nov. 29, 1932. G. W. PIERCE 1,889,153

ACOUSTIC ELECTRIC ENERGY CONVERTER

Original Filed Aug. 17, 1928

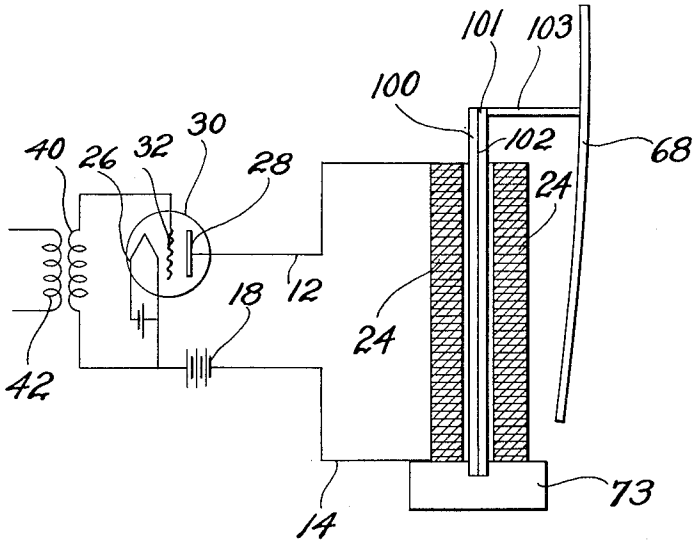

Fig. 1

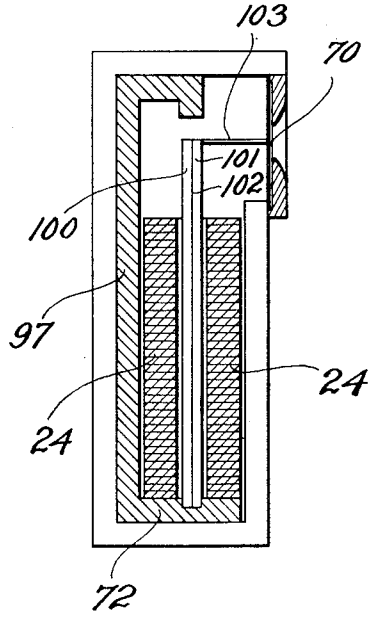

Fig. 2

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ACOUSTIC ELECTRIC ENERGY CONVERTER

Original application filed August 17, 1928, Serial No. 300,248, now Patent No. 1,882,401, dated October 11, 1932. Divided and this application filed February 26, 1931. Serial No. 518,439.

The present invention relates to devices for converting or translating acoustic into electric energy and vice versa, and more particularly to devices of this character operable by magnetostrictive action.

The nature and the objects of the invention will be more fully explained in connection with the accompanying drawing, in which Fig. 1 is a diagrammatic view of circuits and apparatus arranged and constructed in accordance with a preferred embodiment of the present invention, illustrating a loud speaker; and Fig. 2 is a similar view of a modification illustrating a telephone head receiver.

A magnetostrictive core or vibrator is illustrated as in the form of a composite or bimetallic bar, made up of two bars or strips 100 and 101 of dissimilar materials, and welded or otherwise joined together throughout their length along their adjoining surfaces 102. At least one of the bars 100, 101 is constituted of magnetostrictive material. One end of the bimetallic bar may be integrally connected to a weighted mass 73, as illustrated in Fig. 1, to the base 72 of a housing 97, as shown in Fig. 2, or in any other desired manner. The other end of the bar may be connected by an extension rod 103 with a loud-speaker, sound-radiating diaphragm 68, as shown in Fig. 1, a telephone head-receiver diaphragm 70, as indicated in Fig. 2, or with some other sound-radiating or receiving member, as will be understood by persons skilled in the art. The magnetostrictive core is axially positioned within, and driven by, a solenoid field coil or winding 24, with clearance to permit free vibrations. For loud-speaker or telephone purposes, the coil 24 may be connected in the output circuit of a vacuum tube 30, as illustrated in Fig. 1, or in any other desired way. For transmission purposes, the coil 24 may, on the other hand, be connected in the input circuit of the tube 30. The plate 28 of the vacuum tube is shown connected to the coil by a conductor 12, and the filament 26 by a conductor 14, in series with a local battery 18. The grid 32 and the filament 26 are shown in circuit with the secondary coil 40 of a transformer, the primary coil of which is indicated at 42. The tube 30 constitutes a source of alternating electromotive force for the solenoid 24, to enable the latter to drive the magnetostrictive core. The battery 18 may serve also to apply a steady magnetizing or polarizing field to the core, over which the alternating field produced by the generator 30 is superposed. The alternating field is preferably smaller than the steady field, in order that the combined field may not at any time fall to zero. Polarization may be effected in other ways also, as described in Letters Patent No. 1,750,124, granted March 11, 1930, where the theory of the operation is also described in greater detail.

The vibrator being subjected to the alternating electromagnetic field produced by the winding 24, it is caused to vibrate transversely, due to the unequal magnetostrictive operation of the two strips 100, 101, and these vibrations of the composite bar are transmitted to the diaphragm 68 or 70. The vibrations of the vibrator are transverse. On an increase of magnetization, one of the bars 100, 101 expands, while the other (if non-magnetostrictive) remains unchanged or preferably (if it has sufficiently different magnetostrictive properties), contracts, so as to give a flexural vibration to the core. The transverse vibrations of the core are communicated through the connecting rod 103 to the diaphragm 68 or 70, so as to drive the same, the vibrations of the latter, in turn, producing sound vibrations in the air.

The function of the weighted mass 73 of Fig. 1 is described in copending application Serial No. 300,248, filed August 17, 1928, of which the present application is a division. The said application Serial No. 300,248 matured, on October 11, 1932, into Letters Patent No. 1,882,401. The housing 97 of Fig. 2 is shown surrounding the coil 24 and may, if desired, be a magnet or be constituted of magnetic material, and be used for polarizing.

The device herein described is by no means limited to use as an acoustic-electric-energy converter, but may be used for practically any purpose requiring the transformation of mechanical vibrations into electrical, or elec-

trical vibrations into mechanical. The vibrations need not be plural, for a single impulse will produce an effect.

Further modifications will occur to persons skilled in the art, and all such are considered to fall within the spirit and scope of the invention, as defined in the appended claims.

What is claimed is:

1. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive core constituted of mechanically connected members of different magnetostrictive material, and a diaphragm connected with the core.

2. A loud speaker comprising a composite magnetostrictive core constituted of mechanically connected members of different magnetostrictive material, and a sound-radiating member actuated by the core.

3. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive core constituted of mechanically connected members of different magnetostrictive material secured to each other along their length, and a diaphragm connected with the core.

4. A sound radiator comprising a composite magnetostrictive core constituted of mechanically connected members of different magnetostrictive material secured to each other along their length, and a sound-radiating member actuated by the core.

5. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive vibrator constituted of integrally connected members of different mechanical properties, one of the members being magnetostrictive, and a diaphragm connected with the vibrator.

6. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive vibrator constituted of mechanically united members one of which is magnetostrictive and the other of which is not magnetostrictive, and a diaphragm connected with the vibrator.

7. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive vibrator constituted of mechanically connected members of different magnetostrictive material, a base to which one end of the composite vibrator is rigidly attached, and a diaphragm connected with the other end of the vibrator.

8. Apparatus for converting acoustic energy into electric energy or vice versa comprising a composite magnetostrictive core constituted of mechanically connected strips secured to each other along their length, one of the strips being magnetostrictive, and a diaphragm connected with the core.

9. The combination of means for producing a magnetic field, a plurality of magnetostrictive members rigidly mounted at one end and respectively operable to contract and elongate when subjected to said field, a sound diaphragm, and driving means arranged between said diaphragm and said magnetostrictive members.

10. The combination of means for producing a magnetic field, a plurality of magnetostrictive members rigidly mounted at one end and respectively operable to contract and elongate when subjected to said field, a sound diaphragm and driving means arranged between said diaphragm and the free ends of said magnetostrictive members.

11. The combination of means for producing a magnetic field, two magnetostrictive members rigidly mounted at one end and operable to oppositely vary their respective lengths when subjected to said field, a sound diaphragm, and resilient driving means arranged between said diaphragm and the free ends of said magnetostrictive members.

12. The combination of means for producing a magnetic field, two magnetostrictive members each rigidly mounted at one end and respectively operable to contract and elongate when subjected to said field, and a movable member in operative relation with the other end of each of said magnetostrictive members.

13. The combination of means for producing a magnetic field, two magnetostrictive members rigidly mounted at one end and respectively operable to contract and elongate when subjected to said field, a movable member, and driving means arranged between said movable member and the free ends of said magnetostrictive members.

14. A device of the class described comprising a composite core constituted of mechanically connected members having different magnetostrictive properties integrally secured together, and means for transferring mechanical impulses to and from the core.

15. A device of the class described comprising a coil, a core adapted to be subjected to the electromagnetic field of the coil, the core being constituted of mechanically connected members having different magnetostrictive properties integrally secured together, a circuit in which the coil is connected and an extension connected with the core for transmitting mechanical impulses to and from the core.

In testimony whereof, I have hereunto subscribed my name.

GEORGE W. PIERCE.