Feb. 2, 1943. W. J. ALBERSHEIM 2,310,048

VIBRATION TRANSLATING SYSTEM

Filed Sept. 20, 1941

FIG. 1

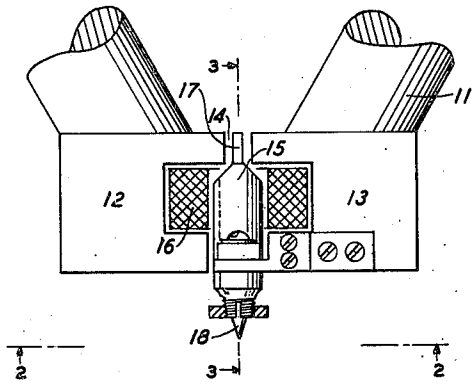


FIG. 2

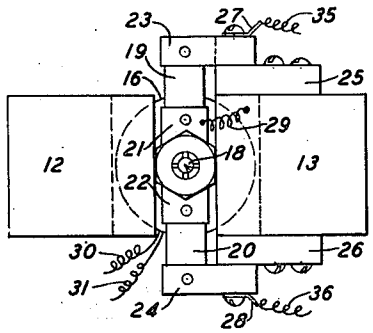


FIG. 3

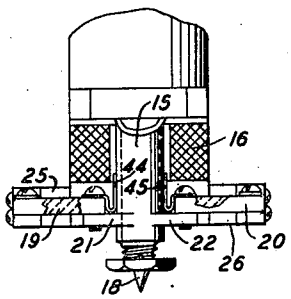
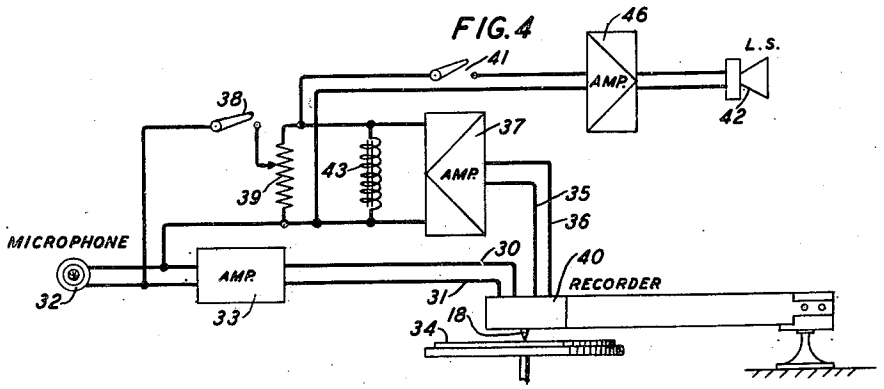


FIG. 4



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VIBRATION TRANSLATING SYSTEM

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9 Claims. (Cl. 179—100.4)

This invention relates to vibration translating devices and the object of the invention is to simplify the construction and improve the operation of such devices.

In using vibration translating devices of the various kinds such for example as phonograph records, it is often desirable to use negative feedback to improve the response characteristic and also to monitor the actual response of the device. In phonograph recording, feedback and monitoring voltages have been obtained heretofore by providing a generating element which is driven by the vibratory structure, but these elements have usually been an addition to the structure of the recorder itself.

According to this invention one or more piezoelectric crystal elements serve both as the resilient mounting for supporting the vibratory structure and also as a source of voltage which may be used for various purposes such as feedback or monitoring or both.

In the drawing:

Fig. 1 is a recorder according to the invention;

Fig. 2 is a bottom view of the recorder of Fig. 1;

Fig. 3 is a partial section of the recorder of Fig. 1; and

Fig. 4 is a circuit showing how such a recorder is connected for the feedback and monitoring.

In Figs. 1 to 3, the electromagnetic recorder shown for purposes of illustration comprises a magnet 11, pole-pieces 12 and 13 defining a gap 14 for the vibratory armature 15 and a coil 16 for receiving the currents representing the signals to be recorded. The armature has a reduced end portion 17 disposed within the gap and at its other end mounts a stylus 18 for cutting the record groove. The crystal elements 19, 20 are attached at one end to wing extensions 21, 22 on the armature and at their other ends to clamping brackets 23, 24 which are mounted on the pole-pieces 13 by means of insulating spacers 25, 26. For the lateral type recorder shown, the crystals are cut in the well-known manner to generate a voltage when torsionally deflected and they are connected so that their voltages are additive in an external circuit connected to the terminals 27, 28. If desired the adjacent terminals 44, 45 may be grounded to the frame of the recorder by means of a wire 29.

When signal currents from the microphone 32 and amplifier 33 are applied to the leads 30, 31 of the coil 16, as shown in Fig. 4, the end portion 17 of the armature will vibrate in the gap 14 in accordance with the signals and the stylus 18 will cut the groove in the record 34, in the well-known manner. As the armature vibrates, the torsional stresses set up in the crystal element will produce corresponding potentials across the terminals 27, 28 and the resulting currents in the leads 35, 36 are applied to the amplifier 37. When the switch 38 is closed, the output of this amplifier is impressed through the volume control 39 on the input of the amplifier 33 as negative feedback to stabilize and improve the response of the recorder 40. When the switch 41 is closed, a portion of the output will energize the loud-speaker 42 and give an audible reproduction of the signals as they are being recorded. Obviously, both the feedback and monitoring circuits may be closed at the same time if desired.

It should be noted, however, that the voltage generated by the crystal element is proportional to the amplitude of the armature vibration whereas the recording system will, in most cases be of the constant velocity type. It will therefore usually be necessary to apply a suitable correcting factor to the output in the amplifier 37, but this may be effected by a simple network and in most cases a shunt inductance 43 will be found satisfactory. When such an inductance is used it should be of considerably lower impedance than the output of the amplifier 37. This involves a loss in power but if necessary additional amplifiers such as 44 may be used as required.

While the invention has been described with reference to a moving iron lateral type recorder, it will be evident that it is equally applicable to devices of various other types, for example, a similar mounting could be used for a moving coil lateral type recorder and in the case of vertical cut recorders or other devices having vertically movable vibratory systems, the crystal element shown could be replaced with others cut in known ways to generate a voltage when bent instead of when torsionally deflected.

What is claimed is:

1. In a vibration translating device, a stationary structure, a vibratory structure, means for driving the vibratory structure and means for resiliently supporting the vibratory structure on the stationary structure comprising a piezoelectric crystal.

2. A vibration translating device according to claim 1 having electrodes associated with the crystal and a feedback circuit from the electrodes to the driving means.

3. A vibration translating device according to claim 1 having electrodes associated with the crystal and a monitoring device connected to the electrodes.

4. A vibration translating system comprising a source of signal current, a vibration translating device having a vibratory system, an amplifier having an input circuit connected to the source and an output circuit connected to the device, a piezoelectric crystal element supporting the vibratory system and generating voltages proportional to the signal current and a work circuit connected to the crystal element.

5. A system according to claim 4 in which the generated voltage is proportional to the amplitude of the vibrations of the vibratory system in combination with means for producing a voltage proportional to the velocity of the vibratory system.

6. A system according to claim 4 in which the work circuit is a feedback path connected to the input of the amplifier.

7. A system according to claim 4 in which the work circuit includes a monitoring device.

8. A phonograph recorder comprising a stationary structure including pole-pieces defining a gap and means for producing a unidirectional flux in the gap, an armature carrying a recording stylus, means for vibrating the armature, and a piezoelectric crystal supporting the armature in operative relation to the gap and generating a voltage proportional to the amplitude of the armature vibration.

9. A recorder in accordance with claim 8 in combination with means for deriving from the generated voltage a voltage proportional to the velocity of the armature vibration, and a work circuit energized by said derived voltage.

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