

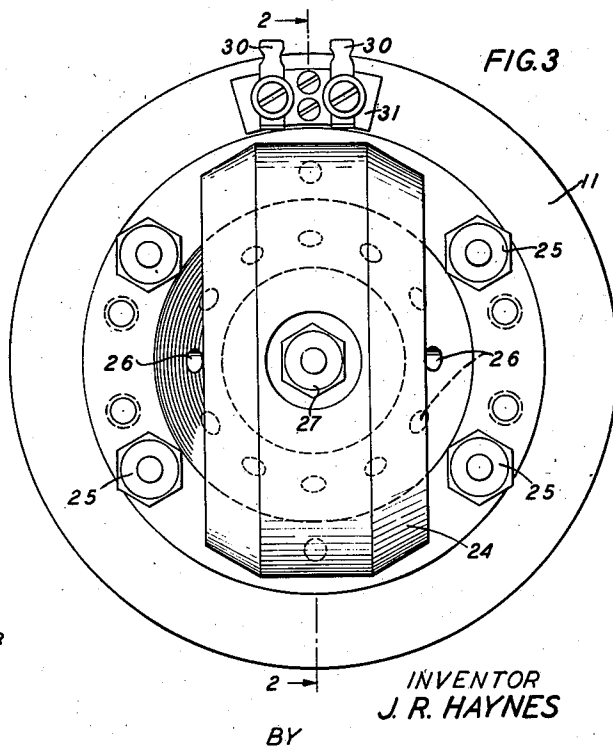
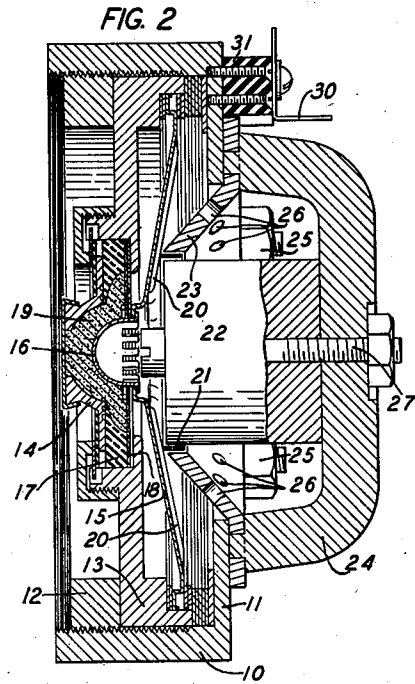
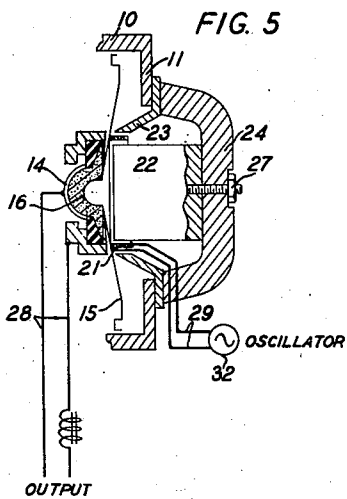
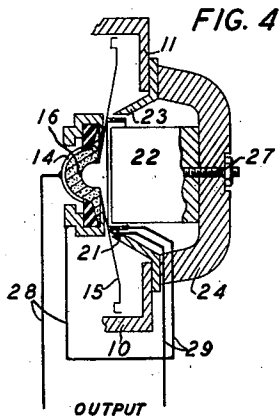
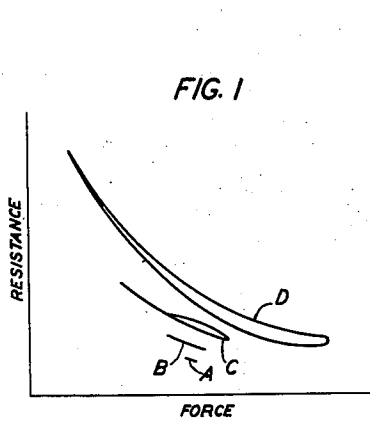
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SIGNAL TRANSLATING DEVICE

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SIGNAL TRANSLATING DEVICE

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4 Claims. (Cl. 179—122)

This invention relates to signal translating devices and more particularly to telephone transmitters.

Carbon granule transmitters comprise, in general, a carbon granule element the resistance of which is varied in accordance with relative movement between a pair of electrodes electrically associated with the element. In a known general construction, one of the electrodes is fixed and the other electrode is coupled to and vibratile with a diaphragm upon which sound waves impinge. The variations in the resistance of the carbon granule element are in general accordance with the amplitude of the diaphragm displacement resulting from the impinging of sound waves thereon.

In such devices, it has been found that the variations in the resistance of the carbon granule element are not strictly proportional linearly to the amplitude of diaphragm motion or displacement and that harmonics are generated when the resistance is varied in accordance with speech waves acting upon the diaphragm so that distortion of the signals being translated results. The distortion, apart from that in frequency response attributable to characteristics of the mechanical system involved, arises from a number of factors, principal among which are changes in the mean resistance of the carbon granule element with changes in the amplitude of diaphragm motion, the non-reversible character of the amplitude-resistance characteristic and increase in the slope of the resistance-force characteristic of the carbon granule with increase in the amplitude of diaphragm motion.

One object of this invention is to improve the translating characteristics of signal translating devices. More specifically, one object of this invention is to reduce distortion in carbon granule transmitters, whereby high fidelity translation of speech and music may be realized.

In accordance with one broad feature of this invention, an electrodynamic element comprising a moving coil and a magnet associated therewith is cooperatively related with the vibratile electrode and so energized as to reduce the distortion due to the characteristics of the carbon granule element.

In one specific embodiment of the invention, the coil of the electrodynamic element is coupled to and vibratile with the diaphragm of the transmitter and is so related electrically with the carbon granule element that when the diaphragm vibrates the force exerted thereon by the coil is 180 degrees out of phase with the force applied to the diaphragm by the sound waves impinging thereon.

In another specific embodiment of this invention, a signal current of a frequency higher than any signal to be translated by the transmitter and of a strength sufficient to cause vibration of

the diaphragm at an amplitude greater than the maximum amplitude due to sound waves impinging upon the diaphragm is supplied to the coil of the electrodynamic element.

The invention and the foregoing and other features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a graph illustrating a typical force-resistance characteristic of a carbon granule transmitter;

Fig. 2 is a side view in section along line 2—2 of Fig. 3 of a telephone transmitter constructed in accordance with this invention;

Fig. 3 is an end view of the telephone transmitter shown in Fig. 2; and

Figs. 4 and 5 are views, partly diagrammatic and partly schematic, illustrating two embodiments of this invention including a transmitter of the construction shown in Figs. 2 and 3.

The nature of the distortions due to inherent characteristics of the carbon granule element in a transmitter will be appreciated from Fig. 1, wherein the several curves indicate the relationship between force on the element and resistance thereof for cyclically varying forces between different amplitude limits. When the applied force varies between fairly close limits, as indicated by curve A in Fig. 1, the mean resistance of the carbon granule element is fairly small and the resistance-force characteristic is substantially linear. When, however, the force variation is over a wider range, as indicated by curves B, C and D, the mean resistance of the element increases correspondingly. Also, it will be noted that the departure from linearity in the force-resistance relation and the slope of the characteristic increase as the amplitude of variation increases. As indicated most clearly by curves C and D, in which the direction of force variations is counter-clockwise, the resistance-force characteristic is non-reversible, that is the characteristic for one-half cycle is different from that for the other half cycle. Thus, because of the inherent characteristics of the carbon granule element, four types of distortion are produced, namely, (a) that due to the curvature of the resistance-force characteristic, (b) that due to the non-reversible character of the resistance-force characteristic, (c) that due to change in mean resistance associated with changes in the amplitude of force variation, and (d) that due to increase in the slope of the resistance-force characteristic with increases in the amplitude of force variation. Several or all of these types of distortion are reduced or substantially eliminated in devices constructed in accordance with this invention.

In one structure illustrative of this invention, shown in Figs. 2 and 3, a telephone transmitter comprises a cylindrical casing member 10

having at one end thereof an inwardly extending flange 11 against which a transmitter unit is secured by a clamping ring 12 threaded to the casing member 10. The unit includes a support 13 on which there are mounted a fixed electrode 14 and a vibratile diaphragm 15 having secured thereto at its center and vibratile therewith an electrode 16. The diaphragm 15 is provided with radially extending ribs or corrugations 20 and is loosely supported at its periphery so that it is vibratile substantially bodily. The electrodes 14 and 16 together with an insulating member 17 and a flexible closure or disc 18 define a chamber which is substantially filled with comminuted resistance varying material, such as carbon granules 19.

Affixed to the ribs or corrugations 20 and coaxial with the diaphragm 15 and vibratile electrode 16 is a cylindrical light weight coil 21 which is disposed in an annular gap defined by pole-pieces 22 and 23, the pole-pieces being associated with a U-shaped permanent magnet 24 magnetized to have its ends of like polarity and its center portion of the opposite polarity. The outer pole-piece 23 is secured to the flange 11, as by a plurality of bolts 25, and, as shown clearly in the drawing, has a frusto-conical portion provided with a plurality of apertures 26 through which sound waves may pass to impinge upon the diaphragm 15. The magnet 24 is secured, as by spot welding, to the pole-piece 23 and supports the inner pole-piece 22 in coaxial relation with the pole-piece 23, the pole-piece 22 being secured to the magnet as by a bolt 27. Suitable leading-in conductors 28 and 29, shown in Figs. 4 and 5, for the electrodes 14 and 16 and the coil 21 are provided and connected to terminals 30 mounted on an insulating block 31 secured to the flange 11.

As illustrated in Fig. 4, in one embodiment of this invention, the electrodes 14 and 16 and the coil 21 are electrically interconnected through the leading-in conductors 28 and 29 therefor, the connections being such that the force applied to the diaphragm 15 due to the passage of current in the coil 21 is 180 degrees out of phase with the force acting upon the diaphragm due to the impingement of sound waves thereon. When the diaphragm vibrates in response to sound waves acting thereon, the coil 21 vibrates accordingly so that a variable current corresponding to the current variations for the granules 19 flows through the coil and consequently a force tending to oppose vibration of the diaphragm is created. Stated in another way, a part of the output of the transmitter is fed back into the transmitter 180 degrees out of phase with the output. Although this results in some decrease in the output current, the quality of transmission is improved and distortion of the four types, noted heretofore, is reduced in amount proportional to the reduction in the output of the transmitter.

In another embodiment of this invention, illustrated in Fig. 5, the coil 21 is actuated independently, as by an oscillator 32, to produce a sinusoidal force of constant amplitude effective upon the diaphragm, the frequency and amplitude of this force being greater than the greatest amplitude and highest frequency of force effective upon the diaphragm due to the impinging of sound waves thereon during operation of the transmitter. It will be appreciated that inasmuch as the diaphragm has nearly the same amplitude of vibration at all times, distortion

due to the rise and fall of the mean resistance of the carbon granule element will be greatly diminished and distortion due to the changes in the slope of the resistance-force characteristic with changes in the amplitude of force variation likewise will be reduced. Distortion due to the non-reversible character of the resistance-force characteristic also will be reduced inasmuch as for high amplitudes of force this characteristic approximates an ellipse in form and a characteristic of this form results merely in a shift of phase without distortion.

Although specific embodiments of this invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. A signal translating device comprising a carbon granule element, a vibratile member cooperatively associated with said element to vary the resistance thereof, and means for reducing distortion of signals translated by said device, due to variations in the force-resistance characteristic of said element, said means comprising electromechanical means coupled to said member and vibratile therewith and means actuating said electromechanical means at substantially constant frequency and amplitude.

2. A telephone transmitter comprising a diaphragm vibratile in response to sound waves, means including a pair of electrodes defining a chamber, one of said electrodes being coupled to said diaphragm and vibratile therewith, carbon granules in said chamber, output terminals connected to each of said electrodes, and means for reducing distortion of signals translated by said transmitter arising from changes in mean resistance of said granules with change in amplitude of diaphragm motion and from increase of the slope of the resistance-force characteristic of said granules with increase in amplitude of diaphragm vibration, said means comprising a coil coupled to said diaphragm and vibratile therewith, means for producing a magnetic field in which said coil is immersed and means for supplying alternating current of substantially constant frequency and amplitude to said coil.

3. A telephone transmitter comprising a diaphragm, means including a pair of electrodes defining a chamber, comminuted resistance varying material in said chamber, one of said electrodes being coupled to said diaphragm and vibratile therewith, and means for varying the resistance of said material at a frequency higher than the highest sound frequency said transmitter is intended to translate and at a constant amplitude greater than the maximum amplitude of vibration of said diaphragm in response to sound waves to be translated impinging thereon.

4. A signal translating device for translating signals within a desired band of frequencies, comprising a variable resistance element including a vibratile electrode, a second electrode and comminuted resistance varying material between said electrodes, means for actuating said element including a vibratile member coupled to said vibratile electrode and responsive to signals within said band, and electromechanical means for vibrating said vibratile electrode at a frequency above said band and at a constant amplitude.

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