Jan. 12, 1926. 1,569,411

P. THOMAS

DYNAMIC TRANSMITTER

Filed April 18, 1922

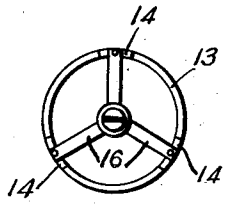


Fig. 2.

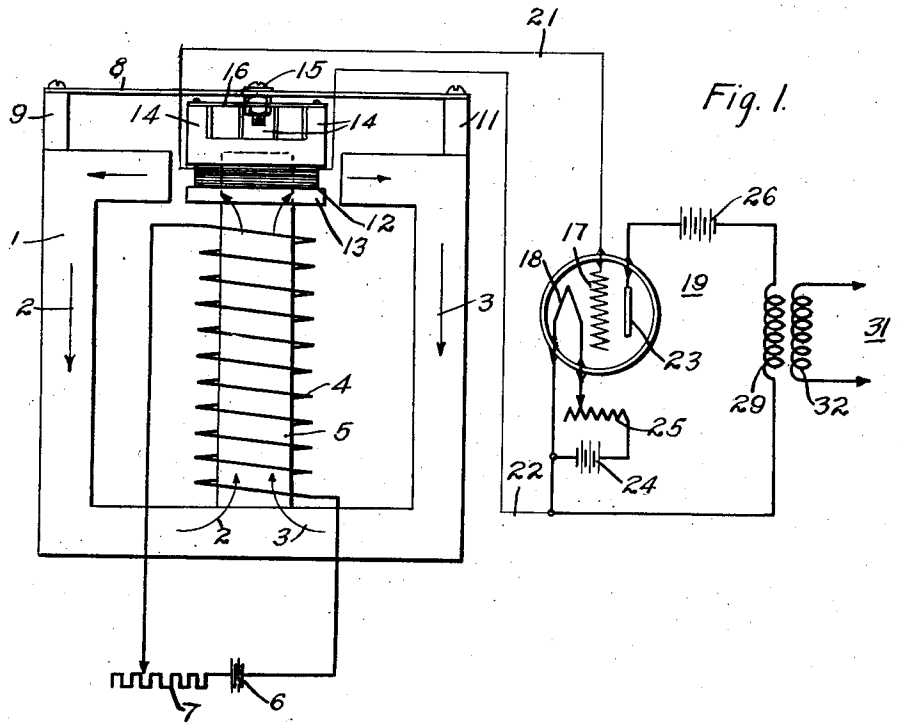


Fig. 1.

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UNITED STATES PATENT OFFICE.

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DYNAMIC TRANSMITTER.

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To all whom it may concern:

Be it known that I, PHILLIPS THOMAS, a citizen of the United States, and a resident of Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Dynamic Transmitters, of which the following is a specification.

My invention relates to telephone systems and apparatus and particularly to telephone transmitters or receivers of the moving coil type.

The principal object of my invention is to provide a microphone of the moving-coil type in which the electrical energy delivered shall be, as nearly as possible, independent of the frequency. If the relation between the electrical output on the microphone and the sound energy input changes with the frequency, there results over-emphasis of certain notes and under-emphasis of other notes in the telephone receiver. By accomplishing the object stated above, this invention avoids such incorrect emphasis.

I have found that the above-mentioned results may be obtained by providing a transmitter of the moving coil type, wherein the natural frequency of the motion of the vibratory elements is low in comparison to the frequency of the lowest sound to be transmitted.

Attempts have been made to produce a microphone having an output independent of the frequency by means of large damping effects. Attempts have also been made to accomplish this result by so designing the microphone that certain moving parts possess a high inertia. Each of these expedients has the disadvantage that the resulting output is very small. It is an object of this invention to produce the undistorted output without greatly diminishing the magnitude of the energy delivered.

I have found that this may be accomplished by making the moving system in two parts connected resiliently. Each of these moving parts has its own natural period of vibration. The combination comprising the two parts and their resilient connection also has a characteristic resonant period of vibration. If all three of these periods are below the period of the lowest sound frequency which the microphone is expected to transmit, the output of the microphone will be very nearly a constant for constant sound amplitude, whatever the frequency.

Other objects and applications of my invention, as well as details of construction, will appear more fully hereinafter.

In the accompanying drawing,

Figure 1 is a view, partially structural and partially diagrammatic, of a distortionless dynamic transmitter embodying my invention;

Fig. 2 is a top plan view of the coil and spring connections shown in Fig. 1.

In the drawing is shown a well-known form of telephone transmitter of the moving coil type, comprising a magnetizable member 1 of E-shape having a pair of interconnected magnetic circuits, as indicated by arrows 2 and 3. The magnetic circuits may be energized by means of an exciting winding 4, which is wound upon a portion 5 of the magnetizable member 1 common to both magnetic circuits, from a direct-current source of energy 6 through an adjustable resistor 7.

A transmitter diaphragm 8 of well-known design is supported upon members 9 and 11 which are rigidly secured to the open end of the magnetizable member 1. A coil 12 is mounted upon a tubular member 13. The diaphragm 8 has a natural period of vibration, which would be its resonant period if it were not loaded with the coil 12 and the parts carrying that coil. In the design of the apparatus, the diaphragm is so dimensioned that this natural period is well below the lowest period of the sounds which the microphone is expected to transmit.

In one form of embodiment of my invention, the member 13 is provided with projecting arms 14 which are connected to a mid point 15 of the diaphragm member 8 by means of spring members 16. The coil 12 is so disposed as to interlink both magnetic circuits, thus admitting of the generation of electromotive forces therein upon vibrations of the coil 12 incident to the vibration of the diaphragm 8. The electromotive forces thus generated in the coil 12 may be impressed upon grid and hot-filament electrodes 17 and 18 of an amplifying device 19 through conductors 21 and 22, respectively. The amplifying device 19, in addition, comprises a customary anode 23. The hot cathode 18 may be energized from a direct-

current source of energy 24 through a resistor 25.

A plate-filament circuit for the device 19 includes a direct-current source of energy 26 and a coupling coil 29. An outgoing or work circuit 31 is operatively connected to the plate-filament circuit through a coupling coil 32 and the coupling coil 29. The outgoing circuit 31 may be further connected to additional amplifying circuits or to other circuits designed to utilize the translated speech waves.

A mathematical analysis of the mechanical action of the vibrating system and the inductive action of the moving coil gives a rather complicated formula for the energy of the current delivered through the conductors 21 and 22. This formula shows that, if the frequency of the force applied to the diaphragm (the sound frequency) is high, compared to (1) the natural period of the diaphragm, (2) the natural period of the system made up of the coil, its support and the springs 16, or (3) the natural period of the whole combination made up of all the moving parts from the coil to the diaphragm, inclusive, the output will be very nearly independent of the frequency. It was assumed, in developing this formula, that the damping is small but, with the apparatus built in the way described above, this assumption is justified.

While distortion is eliminated by giving the diaphragm and moving coil combined a resonant frequency which is low in comparison to that of the disturbing impulses, the amplitude of the electromotive forces generated in the coil 12 is somewhat reduced by reason of the relatively large inertia of the moving parts.

Microphones, in which the uniform character of the output for uniform sound energy is obtained by damping the motion or by increasing the inertia of the moving parts, have the disadvantage that, at all frequencies, the amplitude and, therefore, the output is small, requiring very great amplification before it can be used to actuate a telephone receiver. The microphone herein described obtains an output of this character without very greatly diminishing the amplitude of the movement of the coil and, consequently, only a slight degree of amplification is needed in order to reproduce the sounds in a telephone instrument.

While I have shown only one embodiment of my invention, it is capable of various changes and modifications without departing from the spirit thereof and I desire, therefore, that only such limitations shall be made thereon as are imposed by the prior art or specifically set forth in the appended claims.

I claim as my invention:

1. A translating device comprising means capable of being set into periodic motion by vibratory energy arriving from without the device, and vibratory means for converting said periodic motion into another form of energy, said vibratory means having a natural period of vibration differing from the frequency of said external energy.

2. A translating device comprising means, capable of being set into periodic motion by vibratory energy arriving from without the device, and vibratory means for converting said periodic motion into another form of energy, said vibratory means having a natural period of vibration lower than the lowest frequency of said external energy to which the translating device is intended to respond.

3. A translating device comprising means, capable of being set into periodic motion by vibratory energy arriving from without the device, and vibratory means for converting said periodic motion into electrical energy having a wave-form corresponding to said periodic motion, said vibratory means having a natural period of vibration lower than the lowest frequency of said external energy to which the translating device is intended to respond.

4. A translating device comprising a resilient member adapted to vibrate in accordance with the varying intensity of sound waves and additional vibratory means operatively associated therewith for translating the vibrations of said member into corresponding potential variations, said additional means having a low resonant vibration frequency in comparison to the frequency of said sound waves.

5. A translating device comprising a resilient member adapted to have a motional curve corresponding to the varying intensity of disturbing impulses, a coil, means for establishing a magnetic field in the plane of said coil and flexible means associating said coil and said resilient member, said coil and said flexible means having a combined resonant vibration frequency outside the range of the frequency of said disturbing impulses.

6. A translating device comprising a diaphragm member adapted to vibrate in accordance with the varying intensity of disturbing impulses, a coil member, means for establishing a uniform magnetic field in the plane of said coil and a flexible member so connecting said diaphragm and said coil as to cause the latter to vibrate in said uniform magnetic field in response to the vibration of the diaphragm, said coil and flexible member having a natural frequency of vibration, low relative to that of the lowest of the disturbing impulses.

7. A translating device comprising a diaphragm member adapted to vibrate in accordance with the varying intensity of disturbing impulses, a coil member, means for establishing a uniform magnetic field in the

plane of said coil and a flexible member so connecting said diaphragm and said coil as to cause the latter to vibrate in said uniform magnetic field only in response to the vibration of the diaphragm, said coil and flexible member having a combined resonant frequency of vibration outside the range of the frequency of said disturbing impulses.

8. A translating device comprising means adapted to have a vibratory motion in the presence of disturbing impulses, additional means, including a mechanically vibrating element for providing a source of another form of vibratory energy responsive to the vibrations of said element, and spring means for connecting said first-named means and said element in such manner that said spring means and said element have a natural vibration frequency outside the range of the frequency of said disturbing impulses.

9. In a telephone system, the combination of a diaphragm adapted to vibrate in response to sound, of a means actuated by said diaphragm for producing periodic energy directly proportional to the amplitude of the sound and approximately independent of the frequency of the sound throughout the range of usual musical frequencies.

In testimony whereof, I have hereunto subscribed my name this 17th day of April 1922.

PHILLIPS THOMAS.