Oct. 9, 1928. 1,687,231

J. B. SPEED

TRANSLATING DEVICE

Filed Nov. 19, 1924

Fig. 1

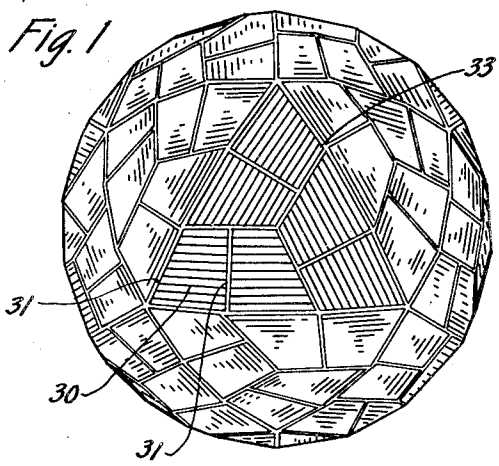


Fig. 2

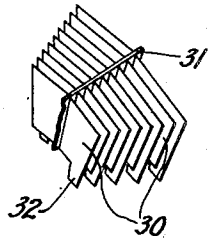
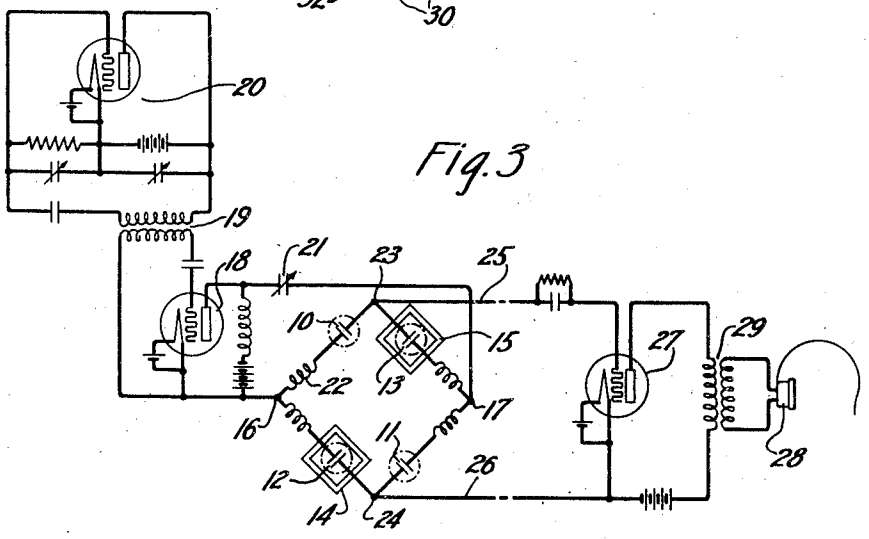


Fig. 3



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UNITED STATES PATENT OFFICE.

JAMES BUCKNER SPEED, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TRANSLATING DEVICE.

Application filed November 19, 1924. Serial No. 750,738.

This invention relates to translating devices and more particularly to devices for interconverting electrical and sound energy.

An object of the invention is directly to convert sound energy into electrical energy and electrical energy into sound energy.

This object is accomplished by utilizing the effect upon the dielectric constant of an air condenser of rarefactions and condensations of the air between the plates and the effect of differences of impressed potential between the plates on the pressure of the air between them.

Another object of the invention is to construct a substantially spherical air condenser by means of which sound energy may be received from or transmitted in all directions.

A condenser of this form may be obtained by assembling a plurality of condenser units, made of metal plates formed into trapezoidal shaped wedge cells, combining a plurality of these units to form an approximately spherical triangular section having a ridge parallel to each leg of the triangle, and uniting several triangular sections to form a substantially spherical body, each unit having its plates extending in a generally radial direction from the center of the sphere.

Referring now to the drawings, Fig. 1 illustrates a substantially spherical condenser constructed in accordance with the invention.

Fig. 2 illustrates in perspective a pair of wedge shaped units of which the condenser is formed, and

Fig. 3 illustrates schematically one embodiment of the invention used as a transmitter.

This invention contemplates the use of an air condenser of sufficiently small dimensions that the space between adjacent plates may be entirely filled or emptied at any one time of either condensation or rarefaction of sound waves, thereby changing its dielectric constant, due to the compression or expansion of the air. In this way, the capacity of the condenser is changed and there results a change of potential between the condenser plates which may be used to change the potential impressed upon a vacuum tube amplifier circuit to accomplish the liberation of electrical energy in an ordinary telephone circuit in a quantity sufficient to reproduce the sound waves by any ordinary reproducing device.

The minute changes of pressure between the plates, however, result in a too small change of capacity to be utilized directly. Therefore, in one embodiment of the invention, use is made of a Wheatstone bridge arrangement having an air condenser in each arm. The condensers in two parallel arms of the bridge are enclosed in sound proof compartments and the other pair are exposed to the speech waves to be transmitted. This arrangement provides a balanced bridge by means of which the capacity of the exposed condensers will be higher or lower than that of the enclosed condensers when a speech wave is impressed thereon. By supplying to two opposite terminals of the bridge a high frequency circuit and connecting the remaining two terminals to a telephone circuit or the like, speech waves impressed upon the condensers cause a flow of current alternately across the bridge to modulate the high frequency current, the modulated wave being transmitted over the telephone line to a demodulating device associated with a receiver whereby the sound impressed upon the condensers may be reproduced.

Referring now particularly to Fig. 3, the condensers 10, 11, 12 and 13 are connected in the parallel arms of a Wheatstone bridge, the condensers 12 and 13 being enclosed in sound proof compartments 14 and 15, respectively. The terminals 16 and 17 of the bridge are connected to the output circuit of a distortionless amplifier 18, the input circuit of which is connected through the transformer 19 with a vacuum tube oscillator 20 for supplying high frequency alternating current to the Wheatstone bridge. A variable condenser 21 may be inserted in one of the leads from the amplifier to tune the Wheatstone bridge to the frequency supplied by the oscillator 20. An induction coil 22 is inserted in each arm of the bridge adjacent the condenser to maintain the individual arms near but not quite at their resonance point.

The terminals 23 and 24 of the Wheatstone bridge are connected by wires 25 and 26 to a vacuum tube demodulator 27, the output circuit of which is connected to any suitable reproducing device such as the receiver 28 through a transformer 29.

It is evident that the high frequency potential impressed on the bridge can be modulated by changes in the dielectric constant of the uncovered condensers, due to the impression of speech waves thereon. The resultant modulated current is impressed on the demodulator 27 to produce corresponding low frequency

currents having a substantially flat transmission characteristic. In this manner there may be reproduced in the receiver 28, the sound waves impressed upon the uncovered condensers.

In order that sound waves may be freely transmitted in or received from all directions, this invention contemplates the use of a substantially spherical condenser having its plates approximately radial thereof. The condenser is composed of a large number of wedge shaped condenser units so designed that they may be combined to form the condenser body. Each unit is composed of a plurality of plates 30 of metal of trapezoidal shape and of graduated dimensions. These plates are equally spaced and two groups of plates have one set of non-parallel edges embedded in a molded partition 31 thereby forming a wedge shaped unit as shown in Fig. 2. These units, however, may be made up of a single set of plates instead of two sets, in which case each plate will have dimensions corresponding to two of the smaller plates Each plate is provided with a tab 32 by means of which conductors may be connected thereto to connect the alternate plates in series.

These units are combined to form a triangular section 33 by taking three sets of wedge shaped units, as shown in Fig. 2, and arranging them with the shorter parallel leg in contact with the oblique leg of a second set and the longer of the parallel legs in alignment with the oblique leg of the third set so that the planes of the plates of each set are at an angle with respect to the planes of the plates of each other set, the intersection of the shorter parallel legs lying beyond the plane of the vertices of the triangle. Preferably, twenty of these triangular sections are united with their edges lying approximately on the arc of a great circle of a sphere thereby forming a substantially spherical body. The planes of the plates of the individual units extend substantially radially of the spherical body thereby permitting transmission and reception of sound waves in all direction.

To obtain the dimensions necessary for the trapezoidally-shaped cell, a spherical surface of the desired size is divided into twenty (20) equal triangles, in which the apices of these triangles are also the apices of an icosahedron, and each side of each of the spherical triangles lies on the arc of a great circle. The spherical triangle is further subdivided by cutting the triangle into three equal segments, that is, by drawing three lines 120° apart from the centre of the triangle and orienting the lines so that they are parallel with the sides of the triangle. Since the surface of the triangle lies on the arc of a great circle, the converging points of the trapezoidal segments are above the plane of the apices of the triangle, and the plane of the segment may be obtained by cutting the spherical surface in a planary line with the sides of the trapezoidal segment. This subdivision results in a substantially spherical body having sixty (60) equal trapezoidal cells which may be further divided by cutting the trapezoidal cell in half whereby one hundred and twenty (120) surfaces may be obtained.

This arrangement provides an easily manufactured condenser, the surface of which comprises a large number of faces of uniform shape and area. As the shape of the condenser units is uniform and dimensions similar, the manufacture thereof is comparatively simple and inexpensive. The resultant body, although not a regular polyhedron, yet comprises a polyhedron having a large number of substantially similar and equal faces.

Although the invention has been described as applied to a special form of condenser transmitter, it is apparent that the principles of the invention may be utilized in converting electrical energy to sound energy by varying the potentials between the plates of an air condenser to produce rarefactions and condensations of the air between the plates. Also the particular method of constructing a polyhedrom having a large number of uniform faces is not limited to the building of a condenser but may be of general application. This method makes possible the construction of a nearly regular polyhedron of a larger number of faces than an icosahedron, that is, a polyhedron of 60 or of 120 equal faces, but each face is, however, not a regular polygon such as a triangle, square or pentagon, but is a trapezoid.

It is, of course, understood that various modifications may be made without in any way departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A translating circuit comprising an air condenser, means to impress a difference of potential between the plates of said condenser and an output circuit connected to said condenser, the spaces between the plates being sufficiently small that the air pressure therein may be varied by sound waves impressed upon the air between the plates whereby the capacity of the condenser is varied to convert the impressed sound waves into electrical vibrations in said output circuit.

2. A translating circuit comprising an air condenser, means to impress high frequency electrical vibrations between the plates of said condenser and an output circuit connected to said condenser, the spaces between the plates being sufficiently small that the air pressure therein may be varied by sound waves impressed upon the air between the plates whereby the capacity of the condenser is varied to modulate the electric vibrations in accordance with the impressed sound waves.

3. A translating circuit comprising a Wheatstone bridge, an air condenser in each arm of said bridge, means for impressing high frequency electrical vibrations upon two opposite terminals of said bridge and an output circuit connected to the other terminals of said bridge, the spaces between the plates of said condensers being sufficiently small that the air pressure therein may be varied by sound waves impressed thereon whereby the capacity of the condenser is varied to modulate the high frequency electrical vibrations in accordance with the impressed sound waves.

4. A translating circuit comprising a Wheatstone bridge, an air condenser in each arm of said bridge, means for impressing high frequency electrical vibrations upon two opposite terminals of said bridge, an output circuit connected to the other terminals of said bridge and sound proof compartments enclosing the condensers in two opposite arms, the spaces between the plates of said condensers being sufficiently small that the air pressure therein may be varied by sound waves impressed thereon whereby the capacity of the condensers is varied to modulate said electrical vibrations in accordance with the impressed sound waves.

5. A translating circuit comprising a Wheatstone bridge, a substantially spherical condenser in each arm of said bridge, means for impressing high frequency electrical vibrations upon two opposite terminals of said bridge, and an output circuit connected to the other terminals of said bridge, each of said condensers having the spaces thereon radially arranged and sufficiently close that the air pressure therebetween may be varied by sound waves impressed thereon whereby the capacity of the condensers is varied to modulate the electrical vibrations in accordance with the impressed sound waves.

6. A translating circuit comprising a Wheatstone bridge, a sound proof compartment enclosing the condensers in two opposite arms of said bridge, means for impressing high frequency electrical vibrations upon two opposite terminals of said bridge, and an output circuit connected to the other terminals of said bridge, each of said condensers having the spaces thereon radially arranged and sufficiently close that the air pressure therebetween may be varied by sound waves impressed thereon whereby the capacity of the condensers is varied to modulate the electrical vibrations in accordance with the impressed sound waves.

7. A translating system comprising a pair of condenser transmitters the capacity of which is variable under control of sound vibrations in the air, a pair of condensers shielded from the effects of sound vibrations, a Wheatstone bridge including said pairs of condensers in respectively opposite arms so that each two adjacent arms include a condenser of each of said pairs, a source of high frequency waves connected in one diagonal of said bridge, and a detector and receiver connected in the other diagonal, each arm of said bridge containing inductance of a value to make each arm nearly resonant at the frequency of said wave source.

In witness whereof, I hereunto subscribe my name this 14th day of November, A. D. 1924.

JAMES BUCKNER SPEED.