No. 644,547. Patented Feb. 27, 1900.

E. B. FAHNESTOCK.

TELEPHONE TRANSMITTER.

(Application filed Jan. 15, 1897. Renewed Aug. 5, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

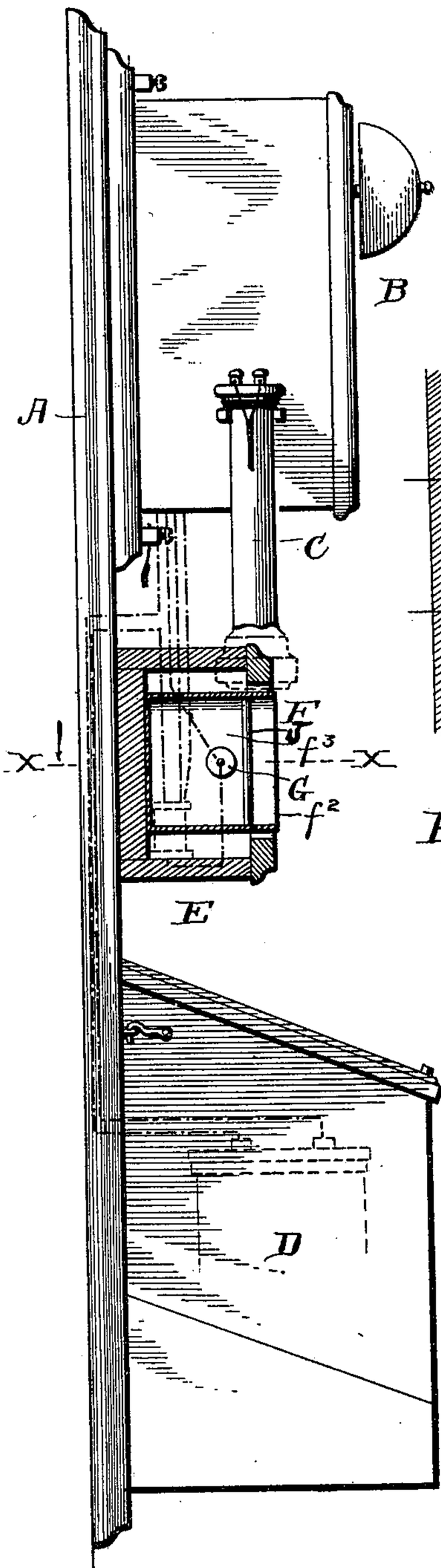


Fig. 6.

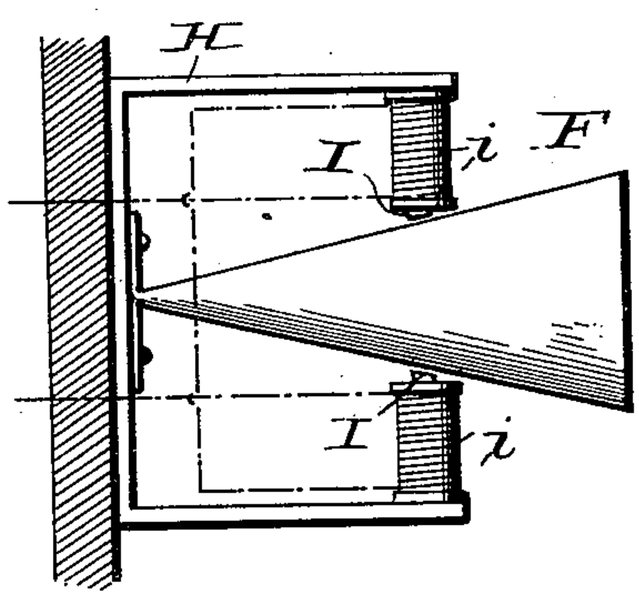
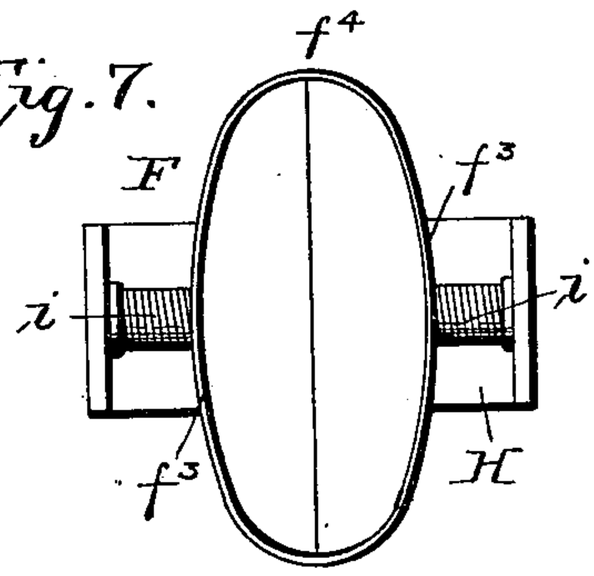


Fig. 7.



Witnesses
Albert Steiden.
Arthur L. Bryant

Inventor
Ernest B. Fahnestock
By H. H. Bliss
Atty

No. 644,547. Patented Feb. 27, 1900.

E. B. FAHNESTOCK.

TELEPHONE TRANSMITTER.

(Application filed Jan. 15, 1897. Renewed Aug. 5, 1899.)

(No Model.) 2 Sheets—Sheet 2.

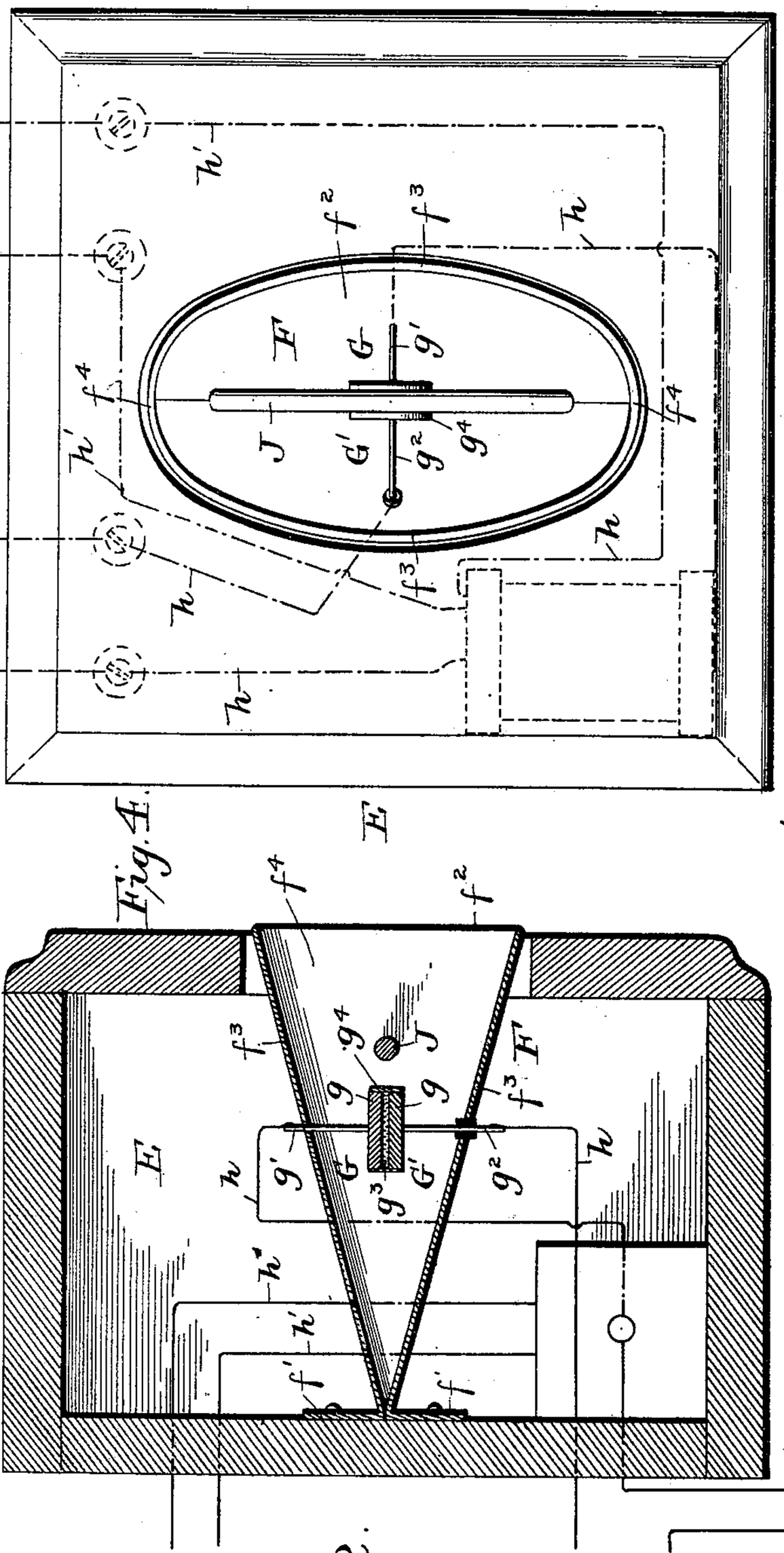


Fig. 4.

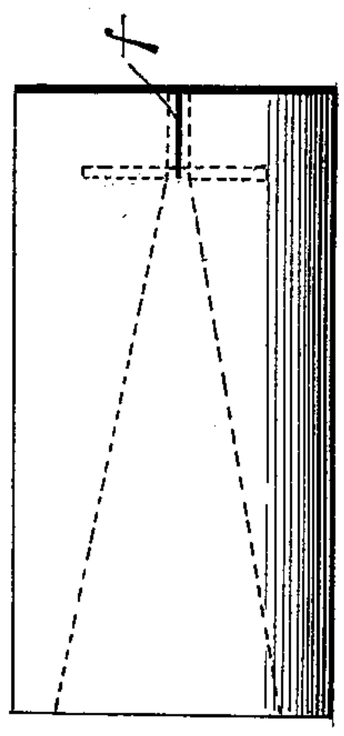


Fig. 5.

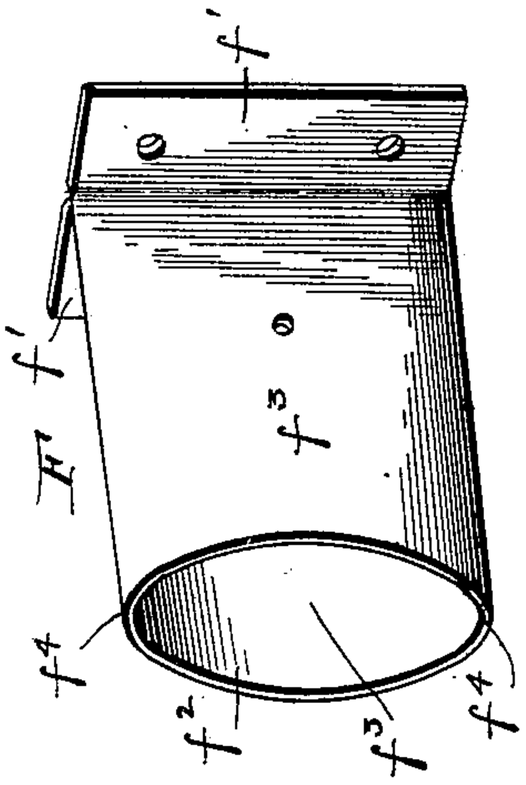


Fig. 3.

Fig. 2.

Witnesses
Albert Speidel.
Arthur L. Bryant

Inventor
Ernest B. Fahnestock
By
H. H. Bliss
atty

UNITED STATES PATENT OFFICE.

ERNEST B. FAHNESTOCK, OF WASHINGTON, DISTRICT OF COLUMBIA, ASSIGNOR TO THE FAHNESTOCK TRANSMITTER COMPANY, OF NEW YORK, N. Y.

TELEPHONE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 644,547, dated February 27, 1900.

Application filed January 15, 1897. Renewed August 5, 1899. Serial No. 726,330. (No model.)

To all whom it may concern:

Be it known that I, ERNEST B. FAHNESTOCK, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Telephone-Transmitters; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

Figure 1 is a vertical section of a telephone apparatus embodying my improvement. Fig. 2 is a transverse section on the line *x x* of Fig. 1 and on a larger scale. Fig. 3 is a perspective of the receiver tube or chamber detached. Fig. 4 is a face view of the parts shown in Fig. 2. Fig. 5 is a view illustrating one manner of making the tube. Fig. 6 is a side view, and Fig. 7 is a face view, of the tube with some of the parts employed in a magneto transmitting system.

In the drawings I have shown in Figs. 1, 2, and others more or less of the parts of an ordinary battery-telephone apparatus for the purpose of clearly indicating one way of applying my invention; but as the details of such an apparatus are now well known it is unnecessary to describe them in detail, it being for the present purpose sufficient to merely call attention to the fact that A indicates the base or back board; B, the signaling-bell, magneto-generator, and accompanying parts; C, an ordinary receiving instrument, and D the battery-box.

E indicates the box or compartment for the transmitting devices.

In telephones as now generally constructed and used the principal part of the transmitter apparatus consists of a thin disk, called the "diaphragm," arranged so as to be transverse to the line or lines along which are propelled the air-vibrations caused by the voice of the one speaking into the transmitter. The resulting vibrations of this diaphragm are utilized to vary a primary-battery circuit in a manner and for a purpose well known; but it has long been understood that a diaphragm of this character has not been as efficient as is desirable in receiving and transmitting the aerial vibrations, and one of the purposes of the present invention is to provide a novel receiving device having several peculiarities in the construction and relations of its parts, so that sound-waves of a given intensity or amplitude shall be translated into larger and stronger diaphragm-vibrations than can be attained with the now-common diaphragm.

I have discovered that the ends aimed at can be attained by accomplishing the following: First, I provide a receiving-chamber which is open at the larger end and continuously narrows or contracts toward the opposite end; secondly, I construct it so that the sound-waves as they enter through the open larger end shall impinge directly upon either or both of two vibratable diaphragm-like walls arranged oppositely to each other and gradually and continuously approaching each other toward the opposite end—that is to say, I arrange the receiving-chamber so that it shall have and generally be composed mainly of two approaching wall portions which are capable of vibrating and assisting each other; thirdly, I prefer to have these two principal wall portions or sides connected by or attached to end portions in such way as to be as perfectly rigid therewith as possible, under many circumstances the best results being attained when these principal wall portions or sides are integral with each other and with the intermediate or connecting side portions, so that the entire structure can be utilized for resonance and to assist in transmitting the vibrations.

In Fig. 3 I have shown detached that form of receiver which I now prefer. It can be made in any of several ways, I generally following the method illustrated—that is to say, I take suitable tubing, which can be cylindrical initially, cut or slit it, as at *f f*, then compress it in such way that it is completely flattened at the cut end, forming two plates *f' f'*, and so that at the opposite end it shall be elliptical in cross-section, or approximately

so, it tapering or gradually flattening as it approaches the plates f'. The flared or wider open-end part is indicated by f^2.

There can be more or less variation from the exact form which I have illustrated; but I have been led to the latter as the result of long and numerous experiments. It will be seen that the receiver-tube can be considered as comprising the two wider and approximately-flat side portions f^3 f^3 and the narrower intermediate connecting or end portions f^4 f^4. It will also be seen that the side parts f^3 become gradually more nearly flat as they approach the inner or closed end. The results attained with a structure or receiver or double diaphragm of this character will be understood from the description which follows: In applying it to a telephone apparatus it can be inserted into a receiver box or compartment E of substantially the ordinary sort. The plates or flanges f' are bent outward and are secured to the backboard A, the receiver-tube or diaphragms being preferably so arranged that the longer axis of the ellipse of the end f^2 is vertical. It is supported entirely by means of its base plate or flanges f', so that with the exception of those parts it is entirely free around its sides and ends to vibrate and can respond to most delicate motions. The one using it speaks into the larger open end, and the sound-waves cause not only vibrations of each diaphragm-like side portion f^3, but also cause each of these to assist or supplement the other.

I am aware of the fact that tubes of various kinds have been used for transmitting sounds and intensifying them along certain lines, the sounds in some cases being received at the larger end and at others at the smaller one; but in all instances within my knowledge these tubular devices, whether tapering or not, have been circular in cross-section, and I have found that for the purposes at which I aim the receiving or transmitting tube must have what I have above described as two opposite diaphragm-like portions which can be separately and independently affected by the sound-waves and can also act to assist or supplement each other. As the waves are received through the larger open end and as the diaphragm-like wall portions converge to a closed end, the force of the air-vibrations can be to a great degree transmitted into the motion of the diaphragms without loss.

When this device is used in a telephone of the character indicated, I provide it with two electrodes G G'. These may be formed and arranged in any of several ways. As shown in Figs. 1, 2, and 4, they consist, essentially, of carbon blocks g and rods g' g^2, respectively supported by the diaphragms f^3 f^3. Powdered carbon, as at g^3, is held between the carbons g g, it being retained by means of any suitable holder which will perform this function and at the same time permit the vibrations of the carbons with the utmost facility—such as a delicate band of silk, a light paper tube, or the like—at g^4. The rods g' g^2 are rigidly but adjustably attached to the diaphragms f^3, and one of them, as that at g', is insulated. The terminals of the battery and the primary coil are connected to these rods g' g^2, though one of them may be connected to any metallic part electrically in circuit with the rod g^2. Such a circuit is conventionally illustrated by h. The circuit of the secondary coil is indicated by h', and it can be connected and arranged in the ordinary or in any preferred manner.

The method of using and the manner of the action of the parts above described will be readily understood. The sound-waves caused by the one speaking into the transmitter are collected and all of their force is utilized in vibrating the diaphragm-like approximately-flat parts f^3 of the tube, and the action upon the adjacent carbons at g is much more intense than is that in the transmitter of the telephones now commonly in use.

I am aware of the fact that various proposals have been made to depart from the transmitter of the ordinary sort and with the expectation of accomplishing the end which I attain. Thus it has been proposed to use devices which divide the sound-waves, compelling a part thereof to enter one chamber and a part to enter another, these chambers having each a diaphragm or vibratable wall opposite to each other and diverging from an apex at the receiving end, being farthest apart at the inner or remote end, and the diaphragms having outside of them casing-walls, with passages or chambers between said walls and the diaphragms; but the action in such a transmitter is in many respects diametrically opposite to that which I aim to have. In my case the diaphragm portions are the farthest apart at the receiving end and converge inwardly, the sound-waves being admitted to the space between them and there being no loss resulting from impinging upon the dead casing-walls. In another instance within my knowledge the proposal was to employ a relatively elongated receiving tube terminating at the outer end in a bell-shaped mouthpiece and to insert into the inner end of the tube a conical plug of wood, the latter being for the purpose of deflecting the sound-waves into a circular or annular chamber, this chamber being bounded on one side by the dead block of wood and on the other by a tubular diaphragm.

The material differences between a device of the character of mine and any of those proposed at earlier periods will be readily understood.

I have above described in detail one form of apparatus adapted to embody my improvements. I will now call attention to the fact that there can be departure from these details and more or less modification in the construction and arrangement of the parts without departing from the invention. These variations or modifications will readily suggest

themselves to those acquainted with such matters. For illustration I refer to the devices shown in Figs. 6 and 7. Here the sound-receiving tube or chamber is the same as above described; but instead of adding to it the devices constituting a battery-transmitter I have indicated those which can be used as a magneto-transmitter. A magnet H can be suitably arranged. It supports cores I I, provided with coils *i i*. The remaining parts of a magneto-transmitter telephone apparatus will be readily understood. The poles of the cores I I are placed at proper distances from the converging diaphragm-like walls f^3, and the latter here act in the manner above described with respect to vibrating and assisting each other. In both cases the sound is reflected from the inner surface of one converging wall or diaphragm to the inner surface of the other, there being an open and practically-unobstructed space extending continuously from the inner surface of one to the inner surface of the other. The best effects in each instance are attained by having the terminals of the magnetic or the electric circuit situated in the transverse planes of this interior sound-chamber which extends from one converging wall to the other. To protect electrodes such as those at G G′, I employ a guard J.

What I claim is—

1. A receiving tube or chamber for telephone transmission, and similar purposes, it having two approximately-flat diaphragm-like parts opposite to each other, and continuously diverging from an inner closed end to an outer, relatively-wider, open, receiving end, each arranged to reflect the sound from its inner surface to the inner surface of the other, substantially as set forth.

2. A tube or chamber for telephone transmission or similar purposes having a relatively-large, open, outer receiving end and formed with two vibratable walls converging continuously toward each other from said open larger outer end, they being arranged to provide a sound-chamber extending continuously from the inner surface of one of the converging walls to the inner surface of the other, in combination with the terminal of an electric or magnetic circuit adjacent to one of the said vibrating walls, and means for supporting the opposing terminal of said circuit, substantially as set forth.

3. A receiving tube or chamber for telephone transmission, or similar purposes, it having outwardly-flaring opposite walls terminating in a closed inner end and a relatively-wider, open, receiving, outer end, each of said walls being arranged to receive the sound directly on its inner surface and to reflect the sound to the corresponding face of the other wall, in combination with two electrodes respectively secured to the said walls and situated in the sound-receiving space between them, substantially as set forth.

4. A chamber for telephone transmission and similar purposes it having two approximately-flat vibratable diaphragm-like parts or walls diverging from their inner ends to an open outer end and arranged to receive the sound directly between the vibrating parts thereof and to reflect it from the inner surface of one to the inner surface of the other as it passes toward the narrower inner end, in combination with an electric or magnetic circuit having one terminal connected with each of said vibrating parts substantially as set forth.

5. A receiving tube or chamber for telephone transmission, or similar purposes, it having outwardly-flaring approximately-flat opposite walls terminating in a closed inner end and diverging continuously from said end to an outer, relatively-wider, open, receiving end each of said walls being adapted to reflect sound from its inner surface against the inner surface of the other, opposite wall and said tube being supported entirely at the inner closed end, whereby the diverging walls are free at all points outside of said inner end to respond to vibrations received against their inner surfaces, in combination with an electric or magnetic circuit adapted to receive and transmit vibrations from said walls substantially as set forth.

6. The tube or chamber for telephone transmission or similar purposes, it having two diverging walls forming a relatively-wide open mouth at their outer ends, each wall being adapted to directly receive the sound on its inner surface, an electrode connected to one of said walls and situated between the inner surfaces of the diverging parts, and another electrode arranged in said chamber between said diverging walls oppositely to the aforesaid electrode, substantially as set forth.

7. A chamber for telephone transmission and similar purposes it being formed of a flattened tube having the relatively-wider approximately-flat converging diaphragm-like sides, and the relatively-narrower intermediate side parts, said chamber expanding continuously from its inner end to a relatively-large, open, outer receiving end, and the said converging parts being adapted to reflect sound from the inner surface of one directly across the intervening space to the inner surface of the other, in combination with an electric circuit having its terminals connected with electrodes carried by and arranged between said diaphragm-like sides of the tube substantially as set forth.

8. In a telephone, the combination of a tube or chamber formed with two vibratable walls diverging outward from a relatively-narrow inner end and adapted to receive sound in the chamber formed between them, and extending from one end of the casing to the other, and an electric or magnetic circuit having one terminal adjacent to one of said vibratable walls and its other terminal adjacent to the other of said vibrating walls and oppo-

site to the first said terminal; substantially as set forth.

9. A tube or chamber for telephone transmission or similar purposes, having two vibratable walls diverging continuously outward from a closed inner end, to provide an intermediate chamber across which sound will be reflected from one of said walls to the other, and each wall having at its rear end a laterally-projecting portion, *f*, by which the tube can be supported; substantially as set forth.

10. A receiving-tube for telephone transmission and similar purposes, it having two oppositely approximately flat, vibratable walls diverging continuously outward from an inner closed end to an outer receiving end, and each adapted to reflect sound from its inner surface to the inner surface of the other wall, and an integral transverse extending support, *f'*, at the inner closed end, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

ERNEST B. FAHNESTOCK.

Witnesses:

HERBERT S. BRYANT,

WM. H. EDWARDS, Jr.