

I. LANGMUIR.  
 TELEPHONE.  
 APPLICATION FILED APR. 21, 1917.

1,380,981.

Patented June 7, 1921.

Fig. 1.

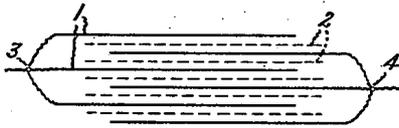


Fig. 2.

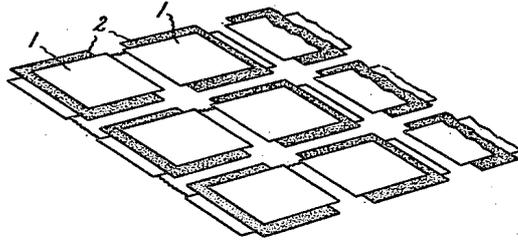


Fig. 3.

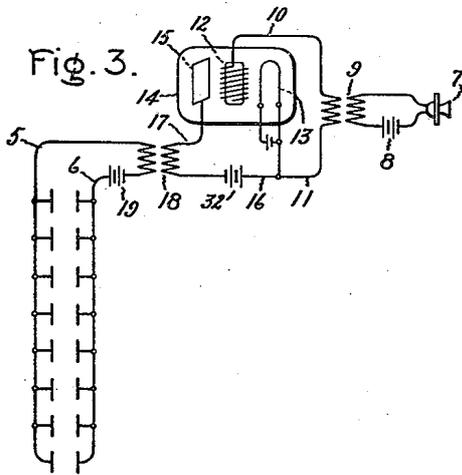


Fig. 4.

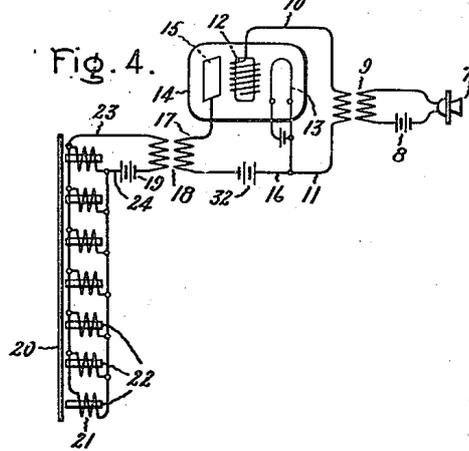


Fig. 5.

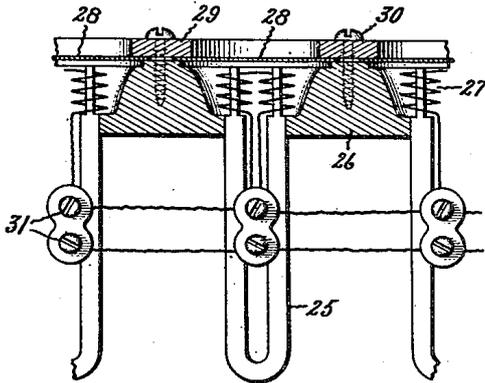
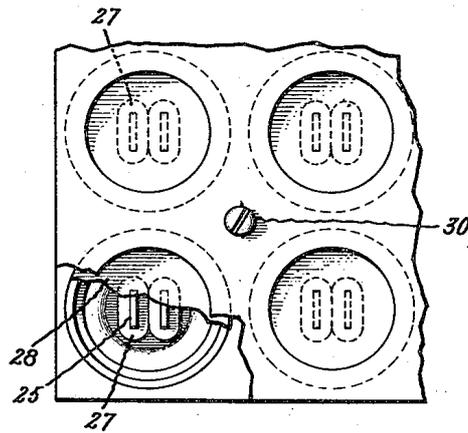


Fig. 6.



Inventor:  
 Irving Langmuir,  
 by *Alfred Davis*  
 His Attorney.

# UNITED STATES PATENT OFFICE.

IRVING LANGMUIR, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE.

1,380,981.

Specification of Letters Patent.

Patented June 7, 1921.

Application filed April 21, 1917. Serial No. 163,730.

*To all whom it may concern:*

Be it known that I, IRVING LANGMUIR, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Telephones, of which the following is a specification.

Loud speaking telephone receivers have been suggested having a diaphragm of relatively large surface area to increase the volume of the sound without introducing the distortion of sound produced by a horn. I have found that a diaphragm of sufficiently large surface if constituted of a continuous sheet and acted upon as proposed by a single reproducer element will vibrate in sections out of synchronism with each other, thereby lowering the efficiency of the sound reproduction.

In accordance with my invention, I have provided a novel diaphragm of large area, preferably of a diameter of at least about two feet which is about the length of sound waves of the most predominant frequency in speech. It is desirable, however, to have the size of the reproducer greater than two feet diameter. The large area diaphragm which is useful either as a receiver or transmitter, consists either of a number of aggregated small diaphragms each with its individual actuating element, that is reproducer or transmitter element, or of a single large size diaphragm acted upon by a number of reproducer or transmitter elements. Such a diaphragm vibrates as a unit. When used as a reproducer the sound produced thereby is free from distortion. The advantages of such a diaphragm as a transmitter will be pointed out hereinafter.

In the accompanying drawings, Figure 1 is a diagrammatic sectional view of an electrostatic telephone unit; Fig. 2 is a plan view of an arrangement of electrostatic units aggregated to form a reproducer of large surface; Fig. 3 is a diagram of electrical connections for a composite electrostatic receiver; Fig. 4 is a diagram of electrical connections for a composite electromagnetic receiver; Fig. 5 is a sectional view of one form of a composite electromagnetic telephone and Fig. 6 is a plan view of part of a composite electromagnetic telephone.

Each electrostatic receiver, as shown in

Fig. 1, consists alternately of sheets of conductive and sheets of dielectric material for example, of tin foil sheets 1 alternating with paper sheets 2. Alternate conductive sheets are electrically connected by conductor 3 and the remaining conductive sheets by a conductor 4. The surface of the electrostatic diaphragm need not be a plane but may be curved if desired.

These electrostatic diaphragms may be of large area, at least of the same order of magnitude as the sound waves, or as shown in Fig. 2 a number of units are placed side by side and electrically connected to form a resultant large diaphragm. For the sake of clearness only a few electrical connections are shown in Fig. 2; the electrical parallel connection being diagrammatically indicated in Fig. 3. As indicated in this figure a conductor 5 is connected respectively to one set of condenser telephone sheets and a conductor 6 to the condenser sheets of opposite polarity. A telephone current may be delivered to these conductors by a suitable telephone preferably connected in circuit with an amplifier. For example, I have shown a microphone transmitter 7, and a battery 8, connected to the primary winding of a transformer 9. The secondary circuit of this transformer is connected by conductors 10, 11 respectively to the grid 12 and the filament cathode 13 of a thermionic relay such for example, as the pilotron described in the Proc. of the Institute of Radio Engineers for September 1915. Inclosed within the evacuated envelope 14 of the relay is also a plate or anode 15, the terminals of the cathode 13, and the anode 15 are connected respectively by the conductors 16, 17 to the primary of a transformer 18. Included in circuit with the cathode and anode is a battery 32, the negative terminal being connected to the cathode. The secondary of the transformer 18 is connected to the conductors 5, 6 in series with a battery 19, which maintains a definite potential on the condensers.

In Fig. 4 I have shown a single large area magnetic telephone diaphragm 20 acted upon by a plurality of magnetic reproducer elements 21, each of which is wound upon a magnetic core 22 and is electrically connected to the conductors 23, 24. The conductors 23, 24 are connected to a suitable transmitter system, a transmitter system

similar to that shown in Fig. 3 being shown as symbolic.

Instead of a single large size diaphragm a number of small magnetic diaphragms, each associated with an individual winding, may be placed side by side to form a transmitter or receiver having a diameter at least as great as the length of the sound waves of the predominant frequency of speech or other sound to be transmitted electrically. As shown in Fig. 5, the magnetic cores are mechanically supported by a base consisting of wood or other suitable insulating material. As shown, the ends of the cores which may be reduced in section, are inserted into holes made in the base, and provided with windings. Adjacent the ends of the magnet cores are fixed magnetic diaphragms, held in position by a cover fastened by screws. The windings may be connected in parallel as shown in Fig. 4, to the conductors at the binding screws. The individual diaphragms vibrating in unison produce substantially the effect of a diaphragm of the combined area of the combined diaphragms.

When used as a reproducer or receiver the sound volume is thus greatly augmented. When a telephone embodying my invention is used as transmitters sound may be gathered from a given direction with a minimum of disturbing sounds being included coming from other directions, and when it is used as a reproducer a "beam" of sound is produced and oriented at will. It is also possible to more perfectly gather sounds coming from a large number of units as for example, an orchestra. When used as a transmitter the conductors 5, 6 of Fig. 3 and the conductors 23, 24 of Fig. 4 are disconnected from the relay transformers and connected to the usual telephone transmission system.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A telephone comprising a diaphragm vibrating in unison over substantially the entire surface thereof and having a diameter at least as great as the length of the predominant sound waves to be transmitted, a plurality of telephone elements arranged to act on individual sections of said diaphragm and means for energizing said elements in unison with a telephonic current.

2. A telephone comprising a plurality of

diaphragms each having such area as to vibrate substantially as a unit, said diaphragms being combined to constitute a surface having a diameter of the order of magnitude of at least about two feet, and means vibrating said members in unison in response to a telephonic current.

3. A telephone comprising a diaphragm having a diameter at least as great as the length of a predominant wave of sound to be transmitted, a plurality of telephone actuating elements in operative relation to said diaphragm, each of said elements acting upon a diaphragm section proportioned to vibrate as a unit, and electrical conductors connecting said elements in parallel.

4. A telephone having a plurality of diaphragm sections associated together to constitute a composite diaphragm having a diameter at least as great as the length of a predominant wave of sound to be reproduced, a plurality of electrostatic telephone reproducer elements, each of which is in operative relation with one of said diaphragm sections and means for operating said reproducer elements to vibrate said composite diaphragm as a unit.

5. A telephonic device comprising the combination of a plurality of diaphragms adapted to individually vibrate as units, said diaphragms being combined to constitute a vibrating surface having a diameter of at least about two feet and a plurality of telephone elements connected electrically in parallel and arranged to cooperate individually with said diaphragms.

6. A telephonic device comprising the combination of a plurality of electrostatic telephones containing vibrating dielectric diaphragms and adapted to individually vibrate as units, said telephones being combined to constitute a composite diaphragm having a diameter of at least about two feet, an electrical circuit connecting the electrodes of said telephones electrically in parallel and an electrical amplifier operatively connected to said circuit.

In witness whereof, I have hereunto set my hand this 21st day of April, 1917.

IRVING LANGMUIR.

Witnesses:

MAX WEISBROD,  
WALTER A. ROMER.