(Model.)

A. G. BELL.

Telephonic Receiver.

No. 241,184. **Patented May 10, 1881.**

Fig. 1.

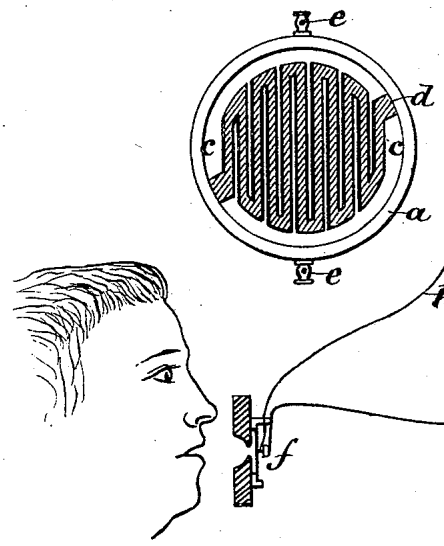


Fig. 2.

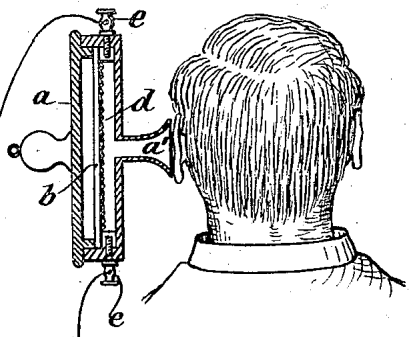
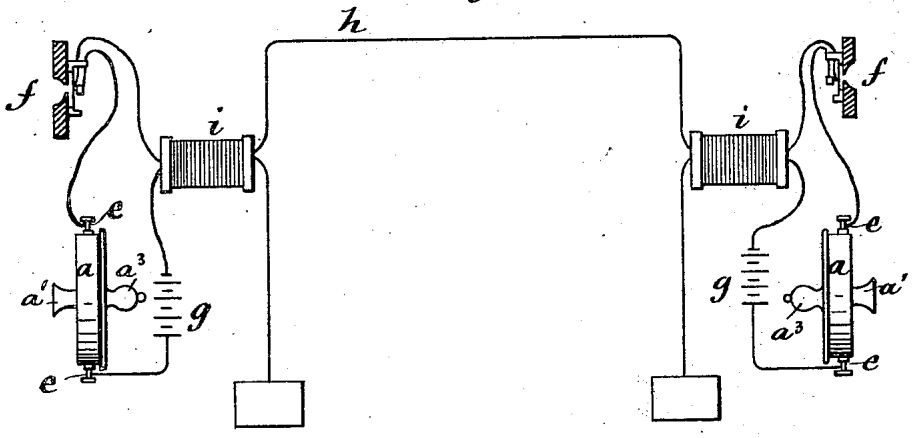


Fig. 3.



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UNITED STATES PATENT OFFICE.

ALEXANDER G. BELL, OF WASHINGTON, DISTRICT OF COLUMBIA.

TELEPHONIC RECEIVER.

SPECIFICATION forming part of Letters Patent No. 241,184, dated May 10, 1881.

Application filed March 24, 1881. (Model.)

To all whom it may concern:

Be it known that I, ALEXANDER GRAHAM BELL, of Washington, in the District of Columbia, have invented a new and useful Improvement in Telephonic Receivers, which invention is fully set forth in the following specification.

This invention relates to a receiving-instrument by which the vibrations or undulations in an electric current produced by the operation of sound-waves upon a suitable transmitting-instrument are converted into sound-waves similar to those which caused said vibrations or undulations.

In the ordinary form of receiving-instrument the sound is reproduced by the action of an electro-magnet upon a thin diaphragm of sheet-iron.

In Letters Patent No. 228,507, granted to me June 8, 1880, a transmitter is described composed of an inflated ball of thin rubber coated with pulverized plumbago, or having particles of plumbago embedded in its walls and held between conducting-points, and it is therein stated that the said transmitter can be used as a receiver, since the passage of an electric current through the plumbago would cause an attraction and repulsion of the particles among themselves, and the resulting vibrations would be communicated to the air as sound-waves. This effect I conceived would follow from the contraction and expansion of the ball under the influence of attraction and repulsion of the conducting particles upon its surface.

In the receiver to which the present invention relates the sound-waves are produced by the action of the electric current upon particles of conducting material; but these particles, instead of being held in a soft elastic and extensible support, such as an inflated ball of thin rubber, and producing sound-waves by causing a contraction and expansion in said ball and support, are so supported that they are capable of free vibration and produce sound-waves by direct action upon the atmosphere. A layer of conducting particles therefore constitutes the vibratory medium. The sound-waves appear to be due to the attraction and repulsion of the particles among themselves under the varying tension of the undulatory current, or to the rise and fall of temperature of the said particles due to the passage of more or less electricity, or to both causes combined. The particles being free to vibrate, the attraction and repulsion among themselves would cause movements which would communicate themselves to the atmosphere. The particles being separated from one another by spaces filled with air, a rise of temperature would expand the particles and diminish the interstitial spaces, so that air would be forced out, while a fall of temperature would cause a contraction of the particles and enlarge said spaces, so that air would be again absorbed. The vibratory medium would therefore act like a sponge, and the air, being alternately absorbed and expelled from said medium, would communicate its movement to the atmosphere, so as to cause sound-waves. As the quantity of air absorbed and expelled varies with the vibrations in the electric current, the sound-waves produced would correspond with the undulations or vibrations of the electric current.

The support for the vibratory medium of metallic particles is a block or plate of insulating material. A hard and rigid material, such as glass, is preferred. The surface of the support may be concave or convex; but a flat surface is generally more convenient and advantageous.

The vibratory medium may be of any suitable conducting material, in small particles or in a flaky or flocculent condition; but the medium with which the best results have been produced, and which is specifically claimed herein, is a layer of lamp-black deposited from the flame of a petroleum-burner or other suitable flame upon the block or plate forming the insulating support, while yet the particles are free to vibrate, and it also has the proper degree of conductivity. The speech reproduced is distinct and clear. Good results are obtained with conducting bodies in a similar physical condition to lamp-black, such as the metals in a spongy condition, spongy platinum, silver, copper, black oxide of manganese, and other metallic compounds.

The electrical current is distributed over a large surface by the aid of numerous conducting-points, divided into two sets and connected with opposite poles of the circuit. The particular object of this arrangement is to magnify the sound.

Heretofore the production of increased loudness of sound has been sought by giving increased amplitude of vibration to the vibrating medium or diaphragm and by using a large diaphragm; but it is practicable to increase the amplitude of vibration of a diaphragm only to a limited extent, and a large body has not the same facility of vibration as a small one, and responds less readily to the moving impulses.

By increasing the surface in vibration, as explained, motion is communicated to an indefinite number of small bodies, and the desired result is obtained, although the amplitude of vibration of the individual particles may be diminished.

To distribute the current equally over the vibratory surface, conductors such as used in the cell described in the application of Mr. Sumner Tainter and myself, filed of even date herewith, for an improvement in photophonic receivers, are preferably adopted. These conductors are made by ruling or scraping a silver film deposited on a glass plate, so as to leave, as it were, two combs with wide-spaced teeth meshing together, but not in contact. The particles of conducting material are placed in the spaces between the two combs. A very large vibratory surface can thus be obtained, the resistance of which can be varied at will within any desired limit by regulating the distance between the two conducting-surfaces. The conductors, however, can be made in various ways and of any desired metals. Comb-like conductors cut from tin-foil and pasted upon glass will answer.

The accompanying drawings, which form a part of this specification, illustrate a telephone-receiver constructed in accordance with the invention.

Figure 1 is a front view of the receiver with a part of the inclosing box or casing removed; Fig. 2, a view representing the receiver in section, partly in elevation, and connected in circuit with an ordinary Blake transmitter; and Fig. 3, a view representing a somewhat modified form of instrument in connection with a transmitter for use at the same station, the receiver and transmitter both being connected with the line-wire by means of an induction-coil.

As shown, the receiver consists of the inclosing-box *a*, which can be constructed to act as a resonator, if desired, a glass plate, *b*, suitably supported in said box, conductors *c*, of silver film, in the form of combs, the vibratory medium *d* included in the space between the said conductors or combs, and the binding-posts *e*, for establishing electrical connection of the conductors with the line-wire. The box or case *a* is shown in Figs. 2 and 3 as provided with a sound-conveying tube, *a'*, the mouth of which can be placed at the ear of the listener, and also with a handle, a^3, by which the receiver can be held to the ear. The sound-waves produced by the vibratory medium are conveyed by the tube *a'* to the ear of the listener. The silver film is deposited upon the glass in any ordinary or suitable way, and is scraped or ruled so as to form the intermeshing combs. The vibratory medium is or may be applied by smoking the silvered side of the glass over the flame of an ordinary petroleum-lamp or other suitable flame.

The transmitter is represented by *f*, the battery by *g*, and the line-wire by *h*. The Blake transmitter is represented, it being the form of instrument now commonly employed; but any other suitable instrument could be used instead.

In Fig. 2 the transmitter, receiver, and battery are connected in the same metallic circuit. Words spoken to the transmitter will be reproduced, and can be heard at the receiver.

In Fig. 3 the transmitter, receiver, and battery are connected in the primary circuit of an induction-coil, *i*, and the line-wire is connected in the secondary circuit of said coil. Words spoken to the transmitter produce electrical undulations in the primary coil, which are repeated by induction on the line-wire, and by a second induction in the primary circuit of the induction-coil at the receiving-station, in the manner well understood, act upon the vibratory medium, so that the spoken words are reproduced.

The receiver is shown connected with the transmitter and battery at its own station in the primary circuit of the induction-coil, because better results are obtained by having the receiver in a galvanic or battery circuit, so that a considerable quantity of electricity passes through the vibratory medium; but it can be placed in the secondary circuit, in the usual way. It can be advantageously employed with the ball-transmitter described in the before-mentioned patent, which is especially adapted to use in the main line.

Modifications may be made in the details of the apparatus without departing from the spirit of the invention, and parts of the invention may be used separately.

It is obvious that if sound-waves or atmospheric vibrations are allowed to fall upon the layer of conducting particles, (lamp-black,) supported as described, they will communicate their movements to the particles and cause variations in the electrical resistance of said layer corresponding to the sound-waves, and that in this manner a telephone-transmitter can be made whereby sound-waves are converted into electrical vibrations or undulations.

Having now fully explained my invention and the manner of carrying the same into effect, what I claim is—

1. A telephonic receiver comprising a vibratory medium of conducting particles and an insulating-support, substantially as described, whereby the said particles are free to vibrate and communicate their vibrations directly to the atmosphere, as set forth.

2. A telephonic receiver having as a vibratory medium a deposited layer of lamp-black, substantially as described.

3. The combination of an electric circuit,

means for producing an undulatory, vibratory, or intermittent current in said circuit, and a receiver comprising a vibratory medium and support of the character described, such as lamp-black upon a glass plate, said medium being included in said circuit and operating to convert the undulations or vibrations of the electric current into sound-waves, substantially as described.

4. The combination, in a telephonic receiver, of a vibratory medium of conducting particles, its support, and conductors for passing an electric circuit through said medium at a number of points, substantially as described.

5. The combination, in a telephonic receiver, with the vibratory medium of conducting particles, of an insulating block or plate forming the support for said medium, substantially as described.

6. A telephonic receiver comprising an inclosing box or case provided with a sound conveyer or opening, a vibratory medium of conducting particles, a block or plate of insulating material forming the support for said medium, conductors for distributing the current over said medium, and connections for joining the line-wires of said conductors, substantially as described.

In testimony whereof I have signed this specification in presence of two subscribing witnesses.

ALEXANDER GRAHAM BELL.

Witnesses:
PHILIP MAURO,
C. J. HEDRICK.