

(No Model.)

S. W. HOLMAN.
TRANSMITTING TELEPHONE.

No. 505,917.

Patented Oct. 3, 1893.

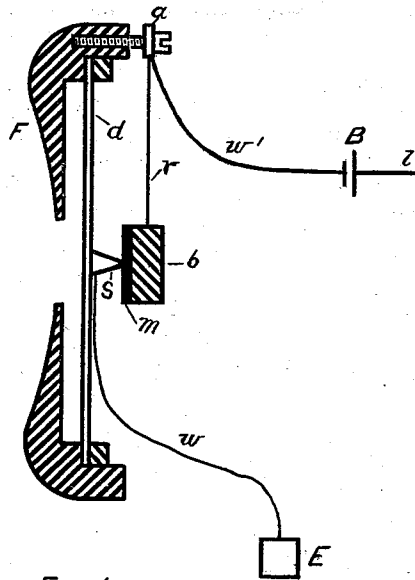


FIG. 1.

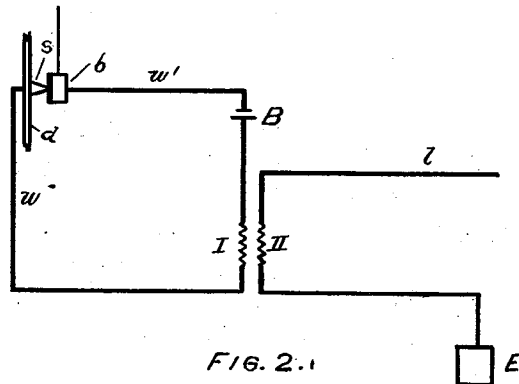


FIG. 2.

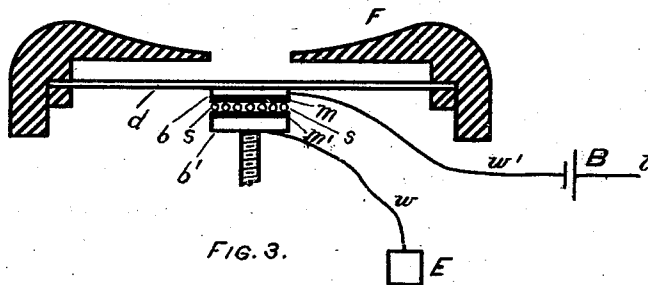


FIG. 3.

WITNESS.

Alfred J. Burrows,
Thomas J. Birmingham.

INVENTOR.

Edw. W. Holman

UNITED STATES PATENT OFFICE.

SILAS W. HOLMAN, OF BOSTON, MASSACHUSETTS.

TRANSMITTING-TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 505,917, dated October 3, 1893.

Application filed May 4, 1893. Serial No. 473,009. (No model.)

To all whom it may concern:

Be it known that I, SILAS W. HOLMAN, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Transmitting-Telephones, of which the following is a specification.

My invention relates particularly to that class of transmitting telephones, described in a patent granted to A. Graham Bell March 7, 1876, and numbered 174,465, in which electrical undulations similar in form to sound waves are occasioned by vibrating a conducting wire or stylus in mercury or other conducting liquid included in the circuit; the operation depending, as stated in the patent, upon the fact that the more deeply the conducting wire is immersed in the mercury or other liquid, the less resistance does the liquid offer to the passage of the current. In a paper published in the *Proceedings of the American Academy of Arts and Sciences* of May 10, 1876, Mr. Bell more fully describes this form of transmitting telephone and mentions, as suitable electrodes, a platinum wire dipping into water, dilute sulphuric acid or a solution of salt and also plumbago vibrating in mercury, in a solution of bichromate of potash, in salt and water and in pure water.

Transmitting telephones of the above described type may be conveniently designated as liquid transmitters, and will be so designated for the purposes of this specification.

Experience with liquid transmitters, as heretofore constructed, shows that while, at times, the transmission of speech by them is beautifully loud and clear, the conditions for such transmission are very difficult to attain and practically impossible to maintain long enough to transmit more than occasional sentences or parts of sentences. Indeed I believe that the necessary conditions have not heretofore been understood, and consequently the liquid transmitter has never come into practical commercial use.

I have made a careful study of the operation of the liquid transmitter, and have invented a form in which the loudness and clearness of the transmitted speech may be indefinitely maintained.

The lack of permanence of adjustment of the liquid transmitter heretofore constructed

is largely due to the fact that the surface of a considerable volume of mercury easily takes up extraneous vibrations which cause little waves that rise and fall upon the immersed electrode a much greater distance than the electrode itself usually vibrates under the influence of the voice, so that the variations of resistance due to these extraneous vibrations are far greater than those due to the voice, and hence the transmission of speech is often completely drowned out by extraneous vibrations. Again the mobility of the volume of mercury as heretofore used has necessitated the construction and use of the instrument in such position that the surface of the mercury shall remain on a level plane, thus greatly limiting the possibilities in construction and convenience in use.

I have found, from a microscopic study of a liquid transmitter, that the motion of the movable electrode need not exceed one ten-thousandth (0.0001) of an inch, even for the loudest transmission of articulate speech, and that the range of vibration of the movable electrode when transmitting speech is usually far less than this. It follows that the volume of mercury into which the movable electrode is immersed need not exceed this depth. I have accordingly substituted for the heretofore used, considerable volume of mercury, with its attendant evils above described, an exceedingly thin layer of mercury, say several ten-thousandths of an inch, spread upon a surface of silver or other metal to which it will adhere. So thin a layer of mercury, in virtue of its adherence to the metal plate, is not easily set in wave vibration by extraneous disturbances, and moreover, may be used with its surface in any desired position.

Other forms of apparatus embodying my invention will readily suggest themselves to those skilled in the art to which this invention pertains; the desiderata being a liquid electrode, consisting of a thin layer or film of conducting liquid preferably maintained in a state of surface tension and a solid conducting electrode adapted to vibrate therein. Thus excellent results are obtained by vibrating two electrodes of plumbago to and from each other with a thin film of a solution of acetate of magnesia and glycerine placed between them, the current in this case entering

the liquid from one solid electrode and leaving it by the other. Excellent results are also obtained by vibrating one or more solid electrodes within a liquid electrode consisting of a solution of acetate of magnesia and glycerine maintained in a thin film analogous to a soap bubble.

A convenient form of telephone transmitter embodying my invention, is shown in diagrammatic cross-section in Fig. 1, in which—

F is a mouthpiece, preferably of wood or vulcanite.

d is a diaphragm of metal, wood, mica or other material, capable of being easily set in vibration by sound waves.

s is a stylus, preferably of plumbago or some other conducting material to which mercury will not readily adhere.

b is a pendulum bob of silver or some other material to which mercury will adhere, having spread over one surface a thin layer of mercury m, the pendulum bob being suspended by a flexible pendulum rod r from the adjustable piece a, which piece by its movement to and from the frame F, brings the surface of mercury m in light contact with the stylus s, so that the stylus will be normally slightly immersed below the surface of the mercury. The electric circuit is from earth E, to wire w, stylus s, mercury m, pendulum bob b, pendulum rod r, wire w', battery B, to line l. If desired, the battery circuit may be a local circuit through the primary of an induction coil, the secondary circuit of which is connected to line as shown in Fig. 2, in which the circuit is from battery B, to wire w', pendulum bob b, stylus s, wire w, primary coil I back to battery B. The secondary coil II of the induction coil has one end connected to line l, and the other to earth E, all as shown.

When very loud reproduction of speech is desired, it is advisable to use several styluses, so that there will be several paths for the current; the resistance of all of which may be simultaneously varied. A convenient form of construction for accomplishing this is shown in Fig. 3, in which F is the mouthpiece, d the diaphragm, b a plate of silver with a thin

layer of mercury m spread thereon, b' a second silver plate having a thin layer of mercury m' spread thereon, b' being held lightly, near to b by any desired mechanism. s s s, &c., is a layer of approximately equal sized granules of plumbago, dipping slightly into the mercury m on one side and the mercury m' on the other. The circuit is from earth E to wire w, plate b', mercury m', in parallel through granules s s s, &c., mercury m, plate b, wire w', battery B to line l.

Having thus fully described my invention and shown how it may be embodied in constructions suitable for convenient use, I claim—

1. In an apparatus for converting sound waves into electrical undulations similar thereto in form, a liquid electrode consisting of a thin stratum of conducting liquid adhering to a conducting surface and one or more solid electrodes dipping into said liquid stratum and adapted to vibrate therein substantially as described.

2. In an apparatus for converting sound waves into electrical undulations similar thereto in form, a pair of liquid electrodes each consisting of a thin stratum of conducting liquid adhering to a conducting surface, either or each of which surfaces is adapted to vibrate toward and from the other and one or more solid conductors between said liquid electrodes and dipping into each.

3. In an apparatus for converting sound waves into electrical undulations similar thereto in form, a liquid electrode consisting of a thin stratum of conducting liquid maintained under the influence of its surface tension throughout its depth, and a solid electrode adapted to vibrate therein.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 29th day of April, 1893.

SILAS W. HOLMAN.

Witnesses:

HARRY ELLSWORTH CLIFFORD,
GEORGE V. WENDELL.