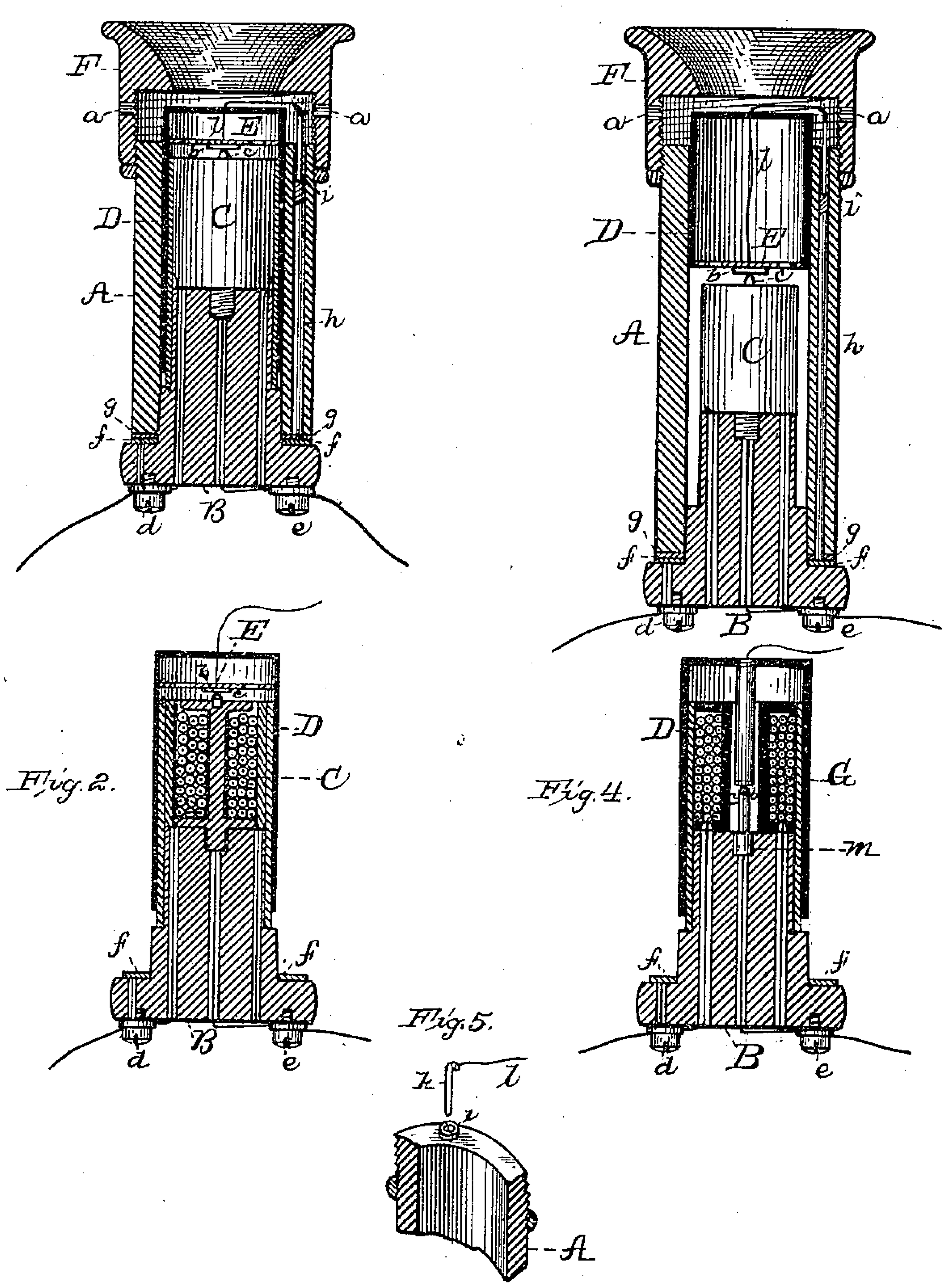
(Model.)

E. H. JOHNSON.

TELEPHONE TRANSMITTER.

No. 381,382. Patented Apr. 17, 1888.

Fig. 1. Fig. 3.



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TELEPHONE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 381,382, dated April 17, 1888.

Application filed April 10, 1884. Serial No. 125,298. (Model.) Patented in England January 16, 1885, No. 652.

To all whom it may concern:

Be it known that I, EDWARD H. JOHNSON, of New York city, in the county and State of New York, have invented a certain new and useful Improvement in Telephone-Transmitters, (patented in England January 16, 1885, No. 652,) of which the following is a specification.

The object of my invention is more especially to produce a practical and efficient telephone-transmitter, for the transmission of articulate speech, employing electrodes of platinum or other suitable metal; but the principal features of the invention can also be used to advantage in carbon telephone-transmitters; and the invention extends to this latter class of instruments as well as to all other forms of telephone-transmitters in which the principles and devices herein described can be employed, although the following description, for clearness and simplicity, is limited to the form of instrument first above mentioned.

I have found in my experiments that in order to get perfect articulation with a transmitter having electrodes of platinum or a similar metal it is necessary that the movable electrode should be capable of moving in perfect unison with the condensations and rarefactions of the atmosphere caused by the vocal organs in speaking. This requires that the movable electrode and the part upon which it is mounted should be without weight, and hence have neither inertia nor momentum; should not be subjected to any external force, so as to be absolutely free to respond to the sound-waves, and should have no elasticity and be incapable of independent vibration—in fact, should be as a part of the air whose movements form the sound-waves. But since the movable electrode and the sound-receiving body by which it is carried necessarily have weight, inertia, momentum, and elasticity, proper means must be provided for balancing or counteracting these forces, for permitting of the free movement of the movable electrode from the position of normal contact, and yet so limiting and controlling its movement that there can be no movement of the electrodes in excess of that due to the condensations and rarefactions of the atmosphere. It is evident, also, that, since the margin for adjustment with platinum electrodes is necessarily small, means should be provided for maintaining a constant adjustment of the electrodes.

Diaphragms or bodies having within themselves vibrating movements I have found unsuitable for the sound-receivers when the best results are desired. I have found it possible to do away with diaphragms entirely, my sound-receiving body being one which is moved bodily back and forth by the sound-waves, and has within itself no capacity for independent vibration.

My sound-receiving body is in fact a piston, which receives the sound-waves directly upon one end and is guided by an inclosing cylinder, or is itself tubular and works upon an internal cylindrical support; or both these methods of guiding the piston may be employed. This piston is made as light as possible, it being a thin shell of aluminum or hard rubber; or it may be made of paper, felt, cork, wood, or other light material. It carries the movable electrode, and when made to slide over an internal support is open at one end and closed at the other; but when not internally supported it may be closed at one or at each end.

The inclosing-cylinder of the instrument is closed at one end—that opposite the mouthpiece—and the piston is made to fit quite accurately the walls of this inclosing-cylinder or the internal cylindrical support, or both. The effect of this construction is to form an air-cushion preventing abnormal movements of the piston. The space between the piston and the closed end of the cylinder, or that within the piston between its closed end and the internal cylindrical support, is a closed space, the air-passage to and from which is formed only by the limited space around the piston; hence for all but movements of limited extent the speed of the piston must be slow. I consider, however, that the elasticity of the confined body of the air permits by its compression and expansion an infinitely rapid movement back and forth of the piston within a small limit, which limit is sufficiently great for all movements that may be required in the proper transmission of articulate speech; but any greater or abnormal movement is checked by the air-cushion, which in this way serves to limit and control the movement of the movable electrode by balancing or counteracting the elasticity and momentum of the parts, which would cause a rebound at the electrodes and a separation thereof. This air-cushion, it will be understood, does not practically detract from the perfect freedom of contact at the electrodes and of movement of the movable electrode within the exceedingly small limit required for its proper vibration.

For maintaining a constant adjustment of the electrodes, I provide a device which automatically brings the electrodes into the proper relative position. In order that the free contact of the electrodes may be preserved, this automatic adjusting device is arranged to be practically inert and inactive when the electrodes are in normal contact, but so as to be brought instantly into action by a movement of the electrodes tending to separate them, and then acting with an excess of power to bring them again into the proper adjustment. For this purpose I use an electrically-operated device—such as an electro-magnet or solenoid—the coils of which bear a shunt relation to the electrodes, so that the contact of the electrodes will short-circuit the magnet or solenoid coils. The magnet-armature or solenoid-core, which is made as light as possible, is carried by the piston. This automatic adjusting device also assists to prevent the separation of the electrodes. A limiting-stop of any suitable character is employed to prevent the piston from dropping out of reach of the attractive force of the magnet or solenoid, as it might otherwise do when the instrument is cut out of circuit. The magnet or solenoid hence will always bring the electrodes into the proper relative position when the instrument is thrown into circuit, and no hand adjustment of any kind will be required.

A further feature of the invention is the use of a definite resistance arranged to be thrown into circuit by movement tending to cause the separation of the electrodes and to be short-circuited by the firm contact of such electrodes. This resistance may be located in a shunt-circuit around the electrodes, forming a constantly-closed shunt-circuit around such electrodes. It is an important element in a transmitter employing electrodes of platinum or other suitable metal. When the automatic adjusting device is employed in the same instrument, the resistance may be formed by the coils of the magnet or solenoid, although additional resistance may be used.

The use of a magnet or solenoid in the shunt-circuit around the electrodes, which magnet or solenoid is thrown into circuit when the electrodes separate, has advantages not possessed by a simple resistance, and is of considerable importance in my instrument. At the instant of movement tending to separate the electrodes the magnet or solenoid sets up a counter electro-motive force opposing the current charging it, and this has the effect of reducing the flow of current to a much greater extent than would be due simply to the introduction into the circuit of the resistance of the magnet or solenoid coils. It also partially or wholly neutralizes the static charge in the circuit and sharpens the current pulsations. I consider that the best result is obtained when the power of the magnet or solenoid is such and the other elements of the circuit are so proportioned that should the electrodes separate the counter force of the magnet or solenoid will completely neutralize the battery-current and the static charge.

The instrument may be provided with openings in the sides of the cylinder-cap to relieve the pressure of "air-rushes" from the piston sound-wave receiver. Frictional terminal connections are made between the sections of the circuits located in the parts of the instrument, so that the act of putting the parts together will complete the connections within the instrument.

In the accompanying drawings, forming a part hereof, Figure 1 is a vertical section of an instrument embodying my invention, the magnet being in elevation; Fig. 2, a separate vertical section of the magnet and piston of this instrument; Fig. 3, a view similar to Fig. 1 of an instrument with a modified form of piston; Fig. 4, a vertical section of the principal parts of an instrument employing a solenoid; Fig. 5, a separate view of the frictional circuit-connection for the movable electrode.

A is the inclosing-cylinder, which is closed at one end by a plug or cap, B, centrally upon which is mounted the magnet C. For compactness this magnet is preferably made, as shown in Fig. 2, of cylindrical form, a shell forming one leg of the magnet, while a core within this shell forms the other magnet-leg. The winding is upon the core within the shell. This magnet does not fill the space within the cylinder A; but upon it works the piston sound-wave receiver D, carrying the armature E. The magnet-shell is preferably covered with a sleeve of hard rubber or other suitable material, upon which the piston slides, it having a long bearing thereon, so as to move without danger of binding. The piston fits this sleeve closely, and also fits closely the walls of the inclosing-cylinder A; but it is evident that the piston may work clear of either the internal or the external cylinder. The armature may be perforated for lightness, and, if not perforated, is secured to the end wall of the piston to give a greater body of air for the cushion before explained.

A cap, F, screws upon the end of cylinder A and forms the mouth-piece. It has openings *a* in its sides to relieve the pressure of air-rushes upon the piston. This cap also limits the movement of the piston, preventing it from moving out of reach of the force of the magnet. The electrodes *b c* of the instrument are of platinum or other suitable metal, one being mounted upon the core of the magnet and the other upon the center of the armature.

The plug B has two binding-screws, *d e*, for connecting the instrument in circuit. The plates into which these screws turn are connected with the two ends of the magnet-coils. The plate of the screw *e* is also connected with the shell of the magnet, and hence with the electrode *c*. The plate of screw *d* is connected with a ring-plate, *f*, on the shoulder of the plug B, and this makes frictional contact with a corresponding plate, *g*, on the end of the cylinder A. A pin, *h*, passes from plate *g* through to the other end of the cylinder, where it is bored out and split to form a socket, *i*, for a removable pin, *k*. The pin *k* is connected by a fine wire, *l*, with the armature, and forms a circuit-connection which can be readily manipulated. By these connections, it will be seen, the magnet-coils and the electrodes are given a shunt relation to each other, the contact of the electrodes short-circuiting the magnet-coils.

In Fig. 3 the piston does not work over the magnet, but is located wholly beyond it, and is guided entirely by the inclosing-cylinder.

In Fig. 4 a solenoid, G, is used instead of the magnet, and this I consider as the equivalent of the magnet. The piston carries the solenoid-core, which is tipped with platinum to form the electrode *b*, while the electrode *c* is carried by a stud, *m*, to which one connection from binding-screw *e* runs.

What I claim is—

1. In a telephone transmitter, the combination, with a sound-receiving body and a stationary electrode, of a movable electrode and a magnet-armature, both carried by said sound-receiving body, and an electro-magnet which is brought into action by a movement tending to separate the electrodes, and then attracts said armature in the direction to draw the electrodes together, substantially as set forth.

2. In a telephone-transmitter, the combination, with a stationary and a movable electrode, of a sound-receiving body carrying the movable electrode and closely fitted within or upon a support, so as to form a closed air-space back of it, which acts as an air-cushion, tending to prevent abnormal movements of such sound-receiving body and the electrode carried by it, substantially as set forth.

3. In a telephone-transmitter, the combination, with a stationary and a movable electrode, of a sound-receiving body carrying the movable electrode, a magnet-armature carried by such sound-receiving body, a magnet brought into action by a movement tending to separate the electrodes and acting in the direction to draw the electrodes together, and an air-cushion back of the sound-receiving body, formed by fitting such body closely within or upon a support, and tending to prevent abnormal movements of such sound-receiving body and the electrode carried by it, substantially as set forth.

4. In a telephone-transmitter, the combination, with electrodes, of an electro-magnet located in a shunt around such electrodes, such magnet acting to draw such electrodes together, substantially as set forth.

5. In a telephone-transmitter, the combination, with electrodes, of an electro-magnet located in a shunt around such electrodes, and an air-cushion, such magnet and said air-cushion acting together to prevent abnormal movements of such electrodes, substantially as set forth.

6. In a telephone-transmitter, the combination, with a sound-wave-receiving body carrying the movable electrode, and a magnet-armature, also carried by such sound-wave receiver, of an electro-magnet acting on such armature and tending to draw the electrodes together, said magnet being located in a shunt around the electrodes, substantially as set forth.

7. In a telephone-transmitter, a sound-wave receiver adapted to move bodily, composed of a hollow cylinder having the characteristic of extreme lightness, and closed at the end receiving the impact of the sound-waves, in combination with electrodes whose relation is affected by the movements of such sound-wave receiver, substantially as set forth.

8. In a telephone-transmitter, the combination, with electrodes, of a sound-wave receiver adapted to move bodily, and a magnet located in a shunt around such electrodes and acting to draw such electrodes together, substantially as set forth.

9. In a telephone-transmitter, the combination, with electrodes, of a sound-wave receiver adapted to move bodily, and a magnet located in a shunt around such electrodes, and an air-cushion, such magnet and said air-cushion acting together to prevent abnormal movements of such sound-wave receiver, substantially as set forth.

10. In a telephone-transmitter, the combination, with the sound-wave receiver D and electrodes *b c*, of the separable shell A B, the contact-plates *f g*, and the circuit-connections therewith, substantially as set forth.

11. In a telephone-transmitter, the combination, with the case, the bodily-moving sound-wave receiver, and the electrodes, one of which is carried by such bodily-moving sound-wave receiver, of the split receptacle *i* in the case, the pin *k*, entering such receptacle, and the wire *l*, extending from such pin to the movable electrode, substantially as set forth.

This specification signed and witnessed this 22d day of March, 1884.

EDWARD H. JOHNSON.

Witnesses:

WM. H. MEADOWCROFT,
ALFRED W. KIDDLE.