(No Model.)

A. K. KELLER & E. H. LYON.

TELEPHONE TRANSMITTER.

No. 335,364. Patented Feb. 2, 1886.

Fig. 1.

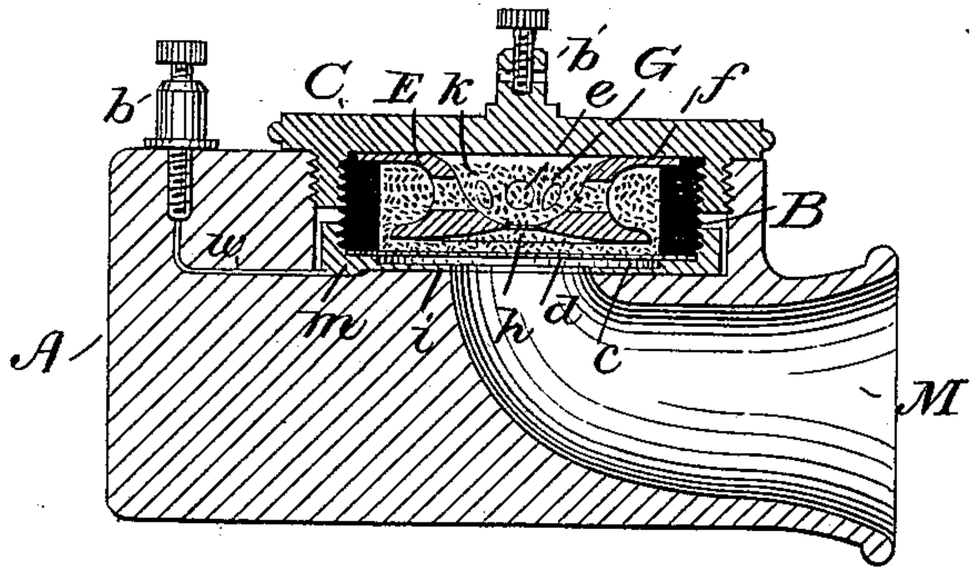


Fig. 2.

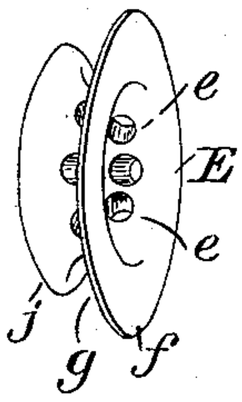


Fig. 3.

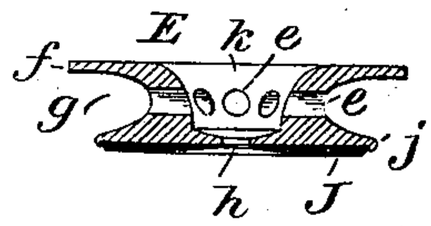
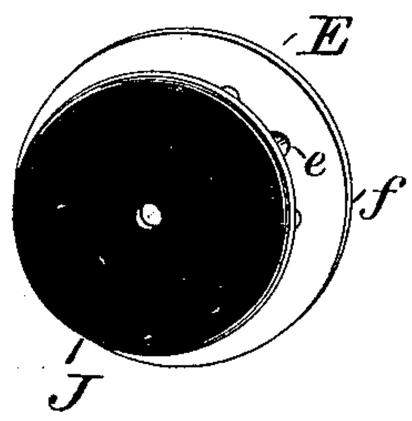


Fig. 4.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 335,364, dated February 2, 1886.

Application filed September 14, 1885. Serial No. 177,061. (No model.)

To all whom it may concern:

Be it known that we, ALBERT K. KELLER, residing at Boston, in the county of Suffolk, and EDWARD H. LYON, residing at Chelsea, in the county of Suffolk, and State of Massachusetts, have invented certain Improvements in Telephone-Transmitters, of which the following is a specification.

Our invention relates to that class of telephone-transmitters in which a granular conducting material constitutes that portion of the circuit the resistance of which is adapted to be varied by means of the vibrations of a diaphragm or vibratory surface influenced by the impact of the sound-waves of the human voice.

The object of our invention is to produce an instrument of greater efficiency and constancy than those heretofore used in the electrical transmission of articulate speech.

We employ a horizontal diaphragm, which receives the sound-waves on its lower surface, while a cavity or case above this diaphragm is formed by a ring of some suitable non-conducting substance — such as vulcanized fiber. The second or complementary electrode hangs upon or depends from the upper edge of the non-conducting ring and nearly fills the cavity, and a mass of granulated conducting material, preferably granular carbon, fills up the chamber and surrounds the second electrode, which is, and by virtue of its special conformation must be, always in contact with the said carbon granulations.

Our invention consists in a transmitter-electrode of a peculiar form, which we have found to possess special advantages in the maintenance of constant excellence of operation; and, furthermore, it consists in combining the same with the vibratory plate, the non-conducting case, and the variable-resistance material, so that while it shall be fully inclosed in the said case and completely or partly immersed in the granulations, its lower surface, which is flat or slightly concave, may be but a slight distance from the diaphragm, which itself constitutes the first electrode. The granules which fill up the intervening space are maintained in a loose and free state, and prevented from packing together, by means of one or more cavities, channels, or reservoirs in the body of the upper electrode, and formed by the space between the said electrode and the walls of the containing-chamber, it having been ascertained in actual practice, when the electrode is in place and the granular carbon is caused to fill the said cavities and the space between the upper and lower electrodes, so that its lower sub-stratum lies upon the diaphragm, that when the diaphragm is vibrated by the voice the granular particles participate in the vibration and, influenced thereby, circulate through the various channels in front of, round the edge, and through the substance of the complementary electrode, effecting a constant motion of the mass as long as the conversation is continued; and in consequence of this motion, which, though slow, is very perceptible, each particle is in turn brought round to the vibrating diaphragm, so that the entire mass is therefore at all times under the control of the diaphragm.

In the drawings by which our invention is illustrated, Figure 1 is a sectional view of a transmitter constructed in accordance with the same. Fig. 2 is a perspective view of the special complementary electrode. Fig. 3 is a cross-section of the same, and Fig. 4 is a second perspective drawing, showing the lower surface of our electrode faced with carbon.

To the end that our invention may be fully understood, we will now describe its nature and construction more specifically, reference being had to the accompanying drawings.

A is the base or block of non-conducting material which constitutes a support for the working parts, and M is the tube or aperture through and into which the speech is uttered. The block A is recessed, so that the working parts may be all secured therein by screws, or otherwise, as preferred.

B is a ring of vulcanized fiber or similar non-conductor, by means of which the vibrating plate *d* is held in place, being stretched between the edge of said ring and a metal plate, *m*, which has a flange, *i*, extending partly over the surface of the vibrating plate, so as to form a condensing-chamber, *c*, in front thereof, whereby the articulations are transmitted in their purity. The metal plate *m* lies in the bottom of the recess, and is by the wire *w* unit-

ed to the binding-screw *b*. The diaphragm *d*, resting on the upper side thereof, and in electrical contact therewith, is thus adapted to form the vibrating electrode by which the electric current is conducted to one side of the variable resistance. The plate *m* is perforated, so that the sound-waves passing through it may reach the diaghragm. The diaphragm itself we prefer to make of silver or platinum foil. The upper or complementary electrode, E, in external form resembles a shade-roller pulley, one of its flanges, *f*, being wider than the other, *j*, and serving as the means whereby the electrode may be attached. The wider flange is the upper one, and rests upon the upper edge of the non-conducting ring B, which forms the wall of the containing-chamber, thereby causing the entire electrode to depend from the said wall, its lower surface, *j*, (which is slightly concave, but which, if preferred, may be flat,) being thus brought very near to the diaphragm, as shown. We have in practice found good results when the surface of the upper electrode is distant one-sixteenth of an inch from the internal surface of the vibratory electrode. Two reservoirs or depositories open from above into the shallow chamber are thus formed between the diaphragm and the upper electrode—one, *k*, through the center, and the other, *g*, at the circumferential edge of the inert electrode. The central reservoir, *k*, is in form like an inverted cone or funnel, and extends vertically through the electrode. The upper orifice or base of the cone-shaped reservoir is flaring, but tapers downwardly, finally terminating in a small hole or opening, *h*, by which carbon or other granules poured in the funnel find access to the diaphragm. The outer reservoir extends entirely round the electrode, and is formed by a groove, *g*, like that in the sheave of a pulley; or the walls of the containing-chamber may be grooved, so as to form the reservoir within them, instead of in the electrode. We also provide several openings, canals, or channels, *e*, which converge laterally from the circumferential groove *g* into the center reservoir, through which the granulated resistance medium may circulate freely from one to the other. These lateral channels are not absolutely essential to the successful operation of our instrument, and we have made and used transmitters with electrodes in which the channels are dispensed with; but the circulation of the carbon particles is more perfect and the operation of the instrument is more perfect when they are introduced. A metal cap may be made to screw down to surmount the hole, and to clamp the electrode E in place by its pressure upon the flange *f*. This arrangement may also constitute the connection with an electric circuit by means of the electric contact thus formed between the flange *f* and the cap C, the latter being suitably provided with a binding-screw attachment, *b'*.

It will be understood that we do not restrict ourselves closely to the above details of construction, nor to any specific ratio between the several parts, inasmuch as either form, material, or size may be greatly and indefinitely varied without departing from the spirit of our invention. We may, for example, employ a homogeneous metallic electrode, as in Figs. 1 and 2, which represent one which we have used with success. We have found it advantageous to use a base of any metal which is easily worked, and to protect the same from the deposition of oxides or sulphides, due to the action of the electricity upon the carbon and vulcanized case, by plating it heavily with a metal not easily attacked by sulphur or oxygen. Accordingly we make our metallic electrode preferably of brass plated heavily with gold; or we may employ an electrode, such as the one shown in Figs. 3 and 4, in which the lower face, J, is formed of solid carbon set in a body or substance of plated metal, as hereinbefore described, and under certain conditions—where, for instance, a large battery is to be employed—this formation is to be preferred. We may also vary greatly the size and number of the lateral channels between the internal and external reservoirs, or even dispense with them altogether, as hereinbefore indicated, and we may also vary the form of the internal reservoir; or, if we so elect, we may form the entire electrode of carbon. The granulated conducting medium G is generally poured into the funnel-formed cavity *k*, and passes through the openings *e* into the side chamber or groove, *g*, and through the opening *h* into the space between the diaphragm and the surface J. It is not, however, essential to the success of the instrument that the carbon be filled in from above; and it is sometimes found convenient to set the upper electrode in place in the containing-chamber and then to invert the same, fill the reservoirs with the granulated carbon, and then attach the diaphragm and diaphragm-holding ring to the lower side of the chamber, thus reversing the order of operation. The containing-chamber is thus filled with the particles of the granulated conductor G, which, when the transmitter is being operated, vibrate in accordance with the vibrations of the diaphragm and change their position continually, thus correspondingly varying the resistance between the vibrating electrode-diaphragm and the inert or stationary electrode E.

A transmitting-telephone made in accordance with the terms of this specification will be found to reproduce in the distant receiver loud and articulate conversation, and is also very durable and reliable.

We claim as our invention—

1. In a telephone-transmitter, a stationary or non-vibratory electrode provided, as described, with internal and circumferential chambers, the said chambers being connected by lateral channels and adapted to be independently supported in the containing-chamber with its lower surface opposite and near to the vibratory electrode.

2. In a telephone-transmitter, a stationary

or non-vibratory electrode constructed, as described, with internal and circumferential reservoirs or chambers, and independently supported in a non-conducting case or containing-chamber with its lower surface opposite and near to the vibratory electrode.

3. In a battery-telephone substantially of the character and class herein described, a stationary electrode provided with an internal chamber or reservoir in the form of an inverted cone extending vertically through its substance, a circumferential chamber or groove formed between the upper and lower flanges and connecting by lateral channels with the inner chamber, and a face of carbon, the whole supported in a containing-chamber, so that the carbon face is held opposite and near to a diaphragm which constitutes the vibratory electrode.

4. In a transmitting-telephone, a stationary or non-vibratory electrode provided, as herein described, with cord-pulley flanges, the upper flange being wider than the lower, having also an internal chamber formed like an inverted cone and continuing vertically through the substance of the said electrode, and an external circumferential reservoir formed by the groove between the upper and lower flange, the said internal and external chamber being connected by lateral channels, and the whole being supported by the upper and wider flange, so that the lower surface is permanently placed near and opposite the vibratory electrode or diaphragm, whereby a granular substance placed between the electrodes and vibrated by sound-waves is enabled to circulate freely through the several chambers, so as to prevent the packing or conglomerating of the same.

5. The combination, substantially as hereinbefore described, in a telephone-transmitter, of a horizontal diaphragm constituting one electrode, a metallic or carbonaceous stationary complementary electrode, in form and character as described herein, a containing-vessel having non-conducting walls, closed on one side by the diaphragm containing the stationary electrode and supporting the same upon its upper edge, and a mass of granulated or finely-divided particles in a loose and free state surrounding and adapted to circulate through the stationary electrode, the said particles being also inclosed within the containing-chamber and resting upon the diaphragm, by which they may be put into vibration.

6. In a telephone-transmitter, a stationary or non-vibratory grooved electrode having an interior funnel-shaped reservoir extending through its substance vertically and provided with flanged sides, the upper of said flanges being larger in diameter and the lower flange smaller in diameter than the containing-chamber of the transmitter, whereby, by making the electrodes of proper thickness, it may be supported by the upper flange in said containing-chamber, with its lower face opposite and near to the diaphragm, leaving a circular aperture between the lower flange and the side of the said containing-chamber, substantially as described.

7. In a battery-telephone, the combination of a horizontal diaphragm or vibratory electrode, a mass of granulated carbon or like material resting thereon, an inclosing-chamber for the said granular carbon, having non-conducting walls and closed in front by the diaphragm, and a stationary complementary electrode depending from the upper edge of the said inclosing-chamber thereinto and into the said granular mass, the said electrode having, as described, grooved chambers communicating with one another, and having a flat or concave surface opposing the vibratory diaphragm a short distance therefrom, whereby the said granular carbon particles, when vibrated by the diaphragm, may circulate freely through and between the several grooves and chambers of the complementary electrode, varying their contact resistance and maintaining their loose and free condition.

8. In a battery-telephone, the combination of the horizontal diaphragm, *d*, constituting the first electrode, the non-conducting inclosing-ring B, forming a closed chamber upon the said diaphragm, the dependent and stationary complementary electrode E, supported by and projecting into the said inclosing-ring and provided with the inner and outer chambers, communicating by channels, as described, the granulated and loose conducting material G serving as a variable-resistance medium resting upon the diaphragm within the inclosing-ring and partly burying the fixed electrode, and the mouth-piece M, by which sound-waves may be directed upon the diaphragm, as described herein.

9. A telephone-transmitter consisting of the following elements in combination: the horizontal diaphragm *d*, the inclosing-ring B, the dependent and stationary electrode E, formed and perforated as described, and the granulated and finely-divided conducting-particles G, substantially as specified.

In testimony whereof we have signed our names to this specification, in the presence of two subscribing witnesses, this 28th day of August, 1885.

ALBERT K. KELLER.
EDWARD H. LYON.

Witnesses:
GEO. WILLIS PIERCE,
GEO. H. E. TROUVELOT.