(No Model.)

B. ABDANK-ABAKANOWICZ.

MICROPHONIC TRANSMITTER.

No. 412,579. Patented Oct. 8, 1889.

Fig. 1.

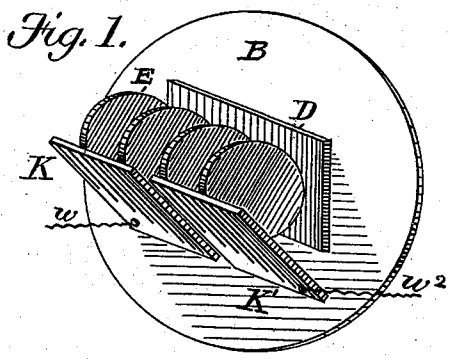


Fig. 2.

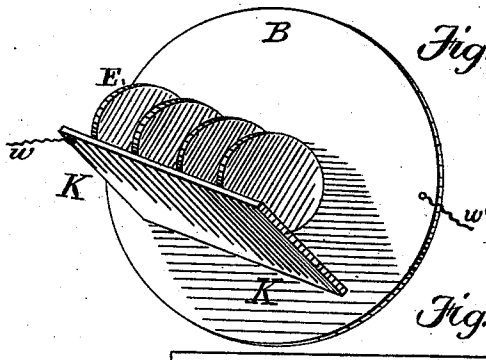
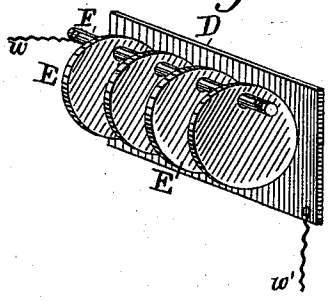


Fig. 4a.

Fig. 3.



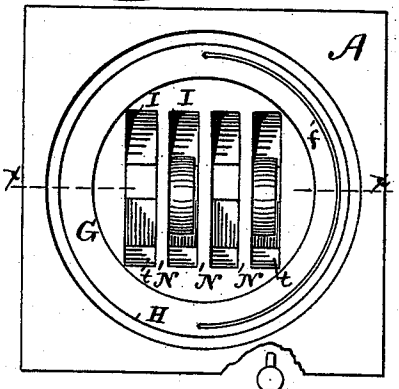


Fig. 4.

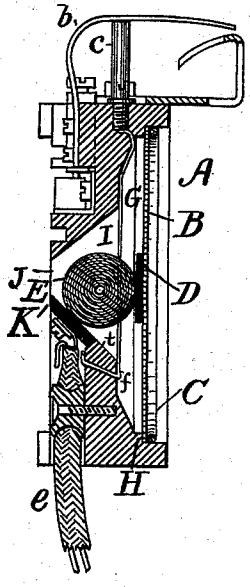


Fig. 5.

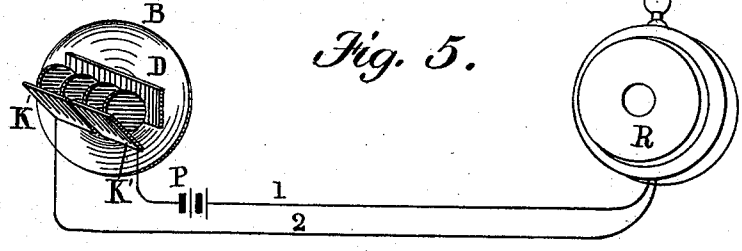


Fig. 6.

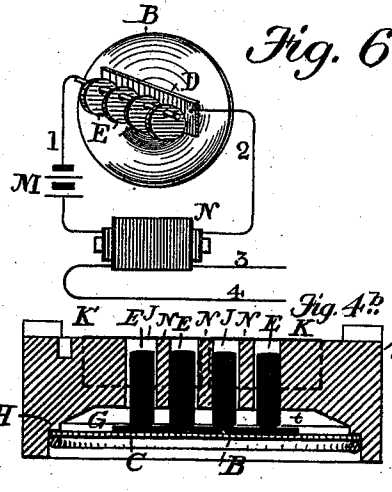


Fig. 4b.

Witnesses.
Fromillis Pierce
UM. Berthold.

Inventor.
Bruno Abdank-Abakanowicz

UNITED STATES PATENT OFFICE.

BRUNO ABDANK-ABAKANOWICZ, OF PARIS, FRANCE, ASSIGNOR TO THE AMERICAN BELL TELEPHONE COMPANY, OF BOSTON, MASSACHUSETTS.

MICROPHONIC TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 412,579, dated October 8, 1889.

Application filed February 20, 1889. Serial No. 300,542. (No model.) Patented in France February 28, 1888, No. 189,018, and in Austria-Hungary April 16, 1888, No. 6,623.

To all whom it may concern:

Be it known that I, BRUNO ABDANK-ABAKANOWICZ, residing at Paris, in the Republic of France, have invented certain Improvements in Microphonic or Contact Transmitters, (for which I have obtained Letters Patent in France, No. 189,018, dated February 28, 1888, and in Austria-Hungary, No. 6,623, dated April 16, 1888,) of which the following is a specification.

This invention relates to the electrical transmission of speech, and is more especially an improvement in the sending or transmitting element of a telephone, the word "telephone," as I understand it, implying the transmitting and receiving instrument at different stations, together with the electric circuit uniting the said stations. This sending-instrument is of that class in which a steady current developed by a suitable source of electricity and traversing a circuit is thrown by means of the voice of a sending operator into undulations or variations "similar in form to the vibrations of the air accompanying vocal" sounds, and is thus caused to affect a receiving-instrument, which reproduces audibly the original sounds. It introduces a current-varying medium or a variable resistance into the circuit, and provides means whereby the voice of the sending operator can be enabled to act upon the said variable resistance, and through its instrumentality vary the current in the manner essential to the complete operation; and since the said variable resistance has solid electrodes or points of conducting material touching each other, and since the intimacy of their contact is varied and the current correspondingly varied by the impact of the voice, this transmitter may be regarded as belonging to the subdivision known as "articulating microphones" or "contact telephones." It may be included, together with its energizing-battery, directly in the main circuit leading to the receiving-instrument, or, in a manner well understood, may, with its battery, be included in the primary circuit of an induction-coil whose secondary circuit forms a part of the main line leading to the receiving-station. It has, however, been designed chiefly for use in the first-mentioned way, and is especially adapted to form one element of a compound instrument and in a system of house or local telephony comprising in one instrument a microphone-transmitter, a magneto-receiver hung when at rest upon the said transmitter, so as to protect and conceal its diaphragm, a circuit-changing switch adapted to transfer the main circuit at will from the bell-alarm to the telephones and the battery from the calling-circuit to the speaking-circuit, and vice versa, the said switch being actuated automatically in the assumption of its resting position by the stem of the telephone when the latter is hung up, and a signal-sending key. This compound instrument, together with the system of circuits with which it is arranged to be operated, constitutes the subject-matter of a separate application for Letters Patent filed contemporaneously herewith and bearing the serial number 300,543.

The invention which forms the subject of the present case comprises a series of movable disk-formed carbon contact-pieces held under the influence of gravity in contact with a fixed electrode or conducting-piece carried by or forming a part of a vibratory diaphragm or tympan, the said disks being made of a density sufficient to prevent them from ever parting company with the said diaphragm, and being all arranged as near as possible to the center of the diaphragm.

It also consists in the combination, with the said series of movable disk-shaped carbon contact-pieces and the diaphragm-carried conductor in contact therewith, of a conducting inclined plane or planes or their equivalent, upon which the said disks rest for the purpose of providing an initial adjustment, and through which the current traversing the circuit reaches the disks.

It also consists in so arranging the several carbon-disks with respect to the contact-surfaces upon which they rest that, although they occupy but a comparatively small space near the center of the diaphragm, they are enabled to effectuate a very considerable variation of current, there being necessarily several contacts both in series and multiple arc.

It also comprises the combination of a suit-

able partitioned frame, within which the several disks are mounted, each disk being separated from the next by a non-conducting partition, the said partitions being arranged like the teeth of a comb, and these not only maintain the disks in their upright position with their edge toward the diaphragm, but serve to dampen their motion by friction between the partitions and the sides of the disks, thus aiding in preserving the absolutely essential continuity of the circuit and preventing breaks between the contacts.

When microphonic contacts are distributed over a large area of the surface of a diaphragm, the articulation of the transmitted speech is marred because of the varying rate and amplitude of the vibrations of different parts of the diaphragm and the consequent non-correspondence in motion of the movable contact-pieces, and experience has demonstrated that the nearer the several contacts are to the center of the diaphragm the better is the result. It has, however, been found very difficult in microphones with freely-movable contact-pieces to combine a multiplicity of such contacts at or near the center of the diaphragm and at the same time to give them a sufficiently great weight or density for the prevention of breaks. To accomplish this is one of the objects of my invention. Other objects are to provide self-damped contacts—an exceedingly simple and economical construction, and generally an instrument requiring an initial adjustment only.

In the drawings which accompany and form a part of this specification, Figures 1, 2, and 3 are representations of different arrangements of the carbon contacts and their supports, all, however, showing the disk-shaped electrodes. Fig. 4 is a vertical section through the working parts of one of my transmitters mounted for work and exhibiting the position of one of the disks. Fig. 4^a shows a front view of the non-conducting frame or mold with the diaphragm removed. Fig. 4^b is a cross-sectional view on the line x x of Fig. 4^a, and illustrates the mode in which the several disks are electrically separated by the partitions of the comb-like frame. Fig. 5 is an electrical diagram indicating symbolically one of my transmitting-instruments connected in circuit with a battery and distant receiver, and Fig. 6 indicates that the transmitter is adapted to work in association with an induction-coil. Figs. 1 and 2, which, as will be seen, differ only in minor details, show simply the actual working parts.

In Fig. 1 a diaphragm B, which may be of wood, glass, or metal, has cemented to its inner surface a conducting-plate D, which may be of metal, but which is preferably of carbon. A pair of conducting-plates K K′, suitably mounted and secured, are, as more clearly shown in Fig. 4, arranged in the position of an inclined plane. These are separated by an air-space at their approximate edges, and are also mounted in the frame so that their lower edge is clear from the diaphragm, and is, in fact, a considerable space in the rear thereof, also as shown in Fig. 4. These plates also are preferably of carbon. A number of carbon disks E are placed between the plate D and the inclined planes, and are supported on their edges in such a way that their tendency to roll down the inclined plane is opposed by their impingement against the diaphragm-plate, this being so mounted as to touch the edge of the disks at or a little below a point on a horizontal plane drawn through the center of the said disks. One of the circuit-wires w is connected with the plate K and the other w' with the plate K′. As these do not directly touch other, the circuit leads from plate K through the two left-hand disks E to the plate D, thence through the two right-hand disks to the plate K′, producing in effect a multiplicity of points of variable resistance both in series and multiple arc, none of which are far from the center of the diaphragm.

Any transmitter intended for work directly in the battery-circuit must be adapted to produce a very considerable variation in the current, and such is the case with my transmitter by reason of the number and position of contacts.

Instead of mounting a conducting-plate D upon the diaphragm to serve as a bridge between the left-handed and right-handed disks, I find it sometimes advantageous to form the entire diaphragm of a suitable conducting material, such as carbon or cast-iron, the latter material having been found particularly suitable for the purpose. This construction is indicated in Fig. 2, in which B is a conducting-diaphragm formed of cast-iron or carbon, serving as the front contact-piece, against which all of the disks impinge. In this figure the inclined plane is in one piece, the single plate K being connected with all of the disks. The wire w is attached thereto, and the other wire w' is connected directly with the diaphragm. The several disks are now arranged in four parallel series of two contacts each, but are, as before, absolutely untrammeled and free to move.

Referring now to Figs. 4, 4^a, and 4^b, the case and mode of mounting the working parts of the transmitter may be described. A convenient frame or mold A may be cut or molded into the desired shape, and may be made of ebonite, papier-maché, or vulcanized fiber. It is recessed in front, as shown, the diaphragm being provided with a resting-shoulder H, behind which is a countersunk vocalizing-chamber G. Still farther back the frame is arranged with alternate spaces I and partitions N, the spaces being open at the rear in apertures J. The front portion t of the floor of each space is of the same material as the frame; but behind this, and crossing the several spaces, the inclined-plane conducting-surfaces K K′, as indicated in dotted lines in Fig. 4^b and in cross-section in Fig. 4, are se-

cured by screws or otherwise. The carbon disks E are placed and stand on edge in the respective spaces I, which are wide enough to contain them loosely, the several partitions N separating the disks from one another. In Fig. 4ª two of the disks E are represented as being in place, while the other two have been removed from the spaces I, so that the apertures J at the rear may be seen. The diaphragm B fits easily within the recess, and resting upon the shoulder is held in place by an expansible elastic and non-continuous annular spring C. When it is required to examine the transmitter, it is only necessary to raise the spring C and to suffer the diaphragm to fall out. The disks E will then roll down the inclined planes and out of their spaces.

To put the instrument together, the frame can be depressed backwardly. The disks are then each placed and the diaphragm dropped into position and secured by the spring C.

In Fig. 4 a switch *b c* and a portion of a telephone-cord are shown, but form no part of this invention. The switch-spring *b* is in direct connection with the main circuit, which is thus continued by the metal standard *c* and the wire *f* (which may be led, as shown in Fig. 4ª, within the recessed chamber G) to one of the inclined planes K, thence through the disks and diaphragm to the other, and by flexible conductor *e* and receiver back to the main circuit. Fig. 4 being a vertical section, the inclined-plane plate to which the wire *f* unites is supposed to be cut off, leaving the end of the said wire detached.

Instead of having the carbon disks E resting upon inclined planes K they may be threaded upon a rod F, as in Fig. 3. In this case the said rod is shown as being both electrically and mechanically continuous, the circuit-wires *w* and *w'* being connected, respectively, with the supporting-rod and the diaphragm-plate. The disk-contacts are thus left absolutely free to vibrate. The adoption of this mode by no means dispenses with the use of the partitioned spaces, each disk being in practice inclosed in its own space I, as herein described. It is not, however, necessary that the comb-like arrangement of spaces and partitions shall actually be integral with the frame. It may be made separately as a rack and suitably secured within the frame, it being only required that the disks shall each be loosely held in a vertical position in partitioned spaces, it having been experimentally ascertained that the comb has a considerable influence upon the clearness of the transmitted voice, the friction between its teeth or partitions and the lateral surface of the disks serving to check the motion of the latter and to prevent breaks or harsh and sudden changes in resistance. Thus I avoid the necessity of special damping devices, which require frequent adjustment.

In Fig. 5 the mode of using the disk-transmitter in direct circuit by means of wires 1 and 2 with a magneto-receiver R and a battery P is indicated, it being of course understood that when so used the receiver must be wound with coarse wire, as otherwise its resistance will too greatly weaken the current. If desired, however, this transmitter may, as shown in Fig. 6 and in a manner well understood, be used in association with an induction-coil, the microphonic contacts being in circuit by wires 1 and 2 with the battery M and the primary circuit of the induction-coil N, the main circuit leading to the distant station being included by wires 3 and 4 in the secondary helix of the said induction-coil.

The mode of operation is obvious. Words spoken in the vicinity of the diaphragm will produce an impact of the air thereon, causing variations in the intimacy of contact between the various contact-surfaces of the disks, the diaphragm, and the inclined planes, these producing corresponding variations of resistance and thereby of current.

An important advantage resulting from this construction is that the several movable contact-pieces, being of disk form, will continue to perform when in operation a slow rotary movement, and will thus constantly present new surfaces to their complementary contacts.

I am aware that heretofore it has been proposed to mount a movable electrode in a telephone-transmitter upon an inclined plane, and also to mount a series of such movable electrodes one behind the other upon an inclined support. So far, however, as my knowledge extends in the former case the said electrodes have been light balls or spheres, and they have been uninclosed and avowedly arranged for the purpose of effecting separation of the contacts in addition to the variation of resistance which ordinarily is required, while in the latter case the contacts between the several elements of the movable electrode are varied necessarily in consecutive succession, those in the rear being a little later than those first acted upon. The variations of resistance between the several members of the movable electrode are therefore not coincident, and the result is defective articulation.

In my transmitter the movable electrode is expressly constructed and arranged to remain at all times in contact with the fixed electrode, and any break of continuity tends to mar the perfection of the reproduced speech. The several disks of carbon which constitute in my instrument the movable electrode can be varied as found necessary without detracting from the necessary weight. They may, for example, be made thinner, provided that their diameter is correspondingly increased; or they may be thinned without any increase in diameter, provided that in that event they are loaded or weighted with some substance of high specific gravity; or lighter disks may be utilized, provided that a greater inclination be given to the angle of the supporting carbon plates.

I claim—

1. In a telephone-transmitter, the combination of a contact-piece carried in a horizontal plane by a vibratory diaphragm and across the central portion thereof, a number of movable disk-formed carbon contact-pieces abutting by the force of gravity peripherally against the diaphragm contact-plate, the said disks being on edge and separated from each other by a non-conducting partitioned frame, as described, and being mounted upon a suitable conducting-support, through which the current traversing the circuit reaches the carbon disks, whereby a multiplicity of variable-resistance contacts may be provided, and whereby the movable contact-pieces may remain untrammeled by connecting-wires, substantially as described.

2. In a microphonic telephone-transmitter, the combination, substantially as hereinbefore described, of a vibratory diaphragm carrying at its center a conducting-plate, a conducting inclined surface mounted in the rear of the said diaphragm, a series of disk-formed freely-movable carbon contact-pieces placed on edge between the diaphragm-plate and the inclined support and adjusted to make permanent but variable contact with the said diaphragm-plate by means of the inclined rear support on which they rest, and a comb-like frame for the said movable carbon disks, separating the said disks from each other and acting to dampen or retard their movement, whereby a series of variable-resistance contacts may be arranged both in series and multiple arc and vibrated by the same diaphragm at a point near the center thereof.

3. In a microphonic transmitter, a series of carbon disk-formed freely-movable contact-pieces, a conducting-support therefor comprising two parts divided electrically from each other and each supporting on edge a part of the entire number of said carbon disks, and a diaphragm-electrode in contact with all of the said disks, whereby they are held in place, the whole being adapted to be included in an electrical circuit, whereby a continuous circuit including a number of resistance-contacts variable by the movements of said diaphragm and arranged in multiple series is constituted between the two insulated parts of the conducting-support, substantially as and for the purposes specified.

4. A telephone-transmitter comprising a series of freely-movable disk-formed contact-pieces of carbon, an inclined-plane conducting-surface consisting of two parts electrically insulated from each other, forming a rear support for the said disks, the said insulated parts each supporting a fractional number of said disks, and a vibratory diaphragm and electrode, with which the peripheries of the said carbon disks are in permanent contact by the influence of gravity, the said electrode forming a conducting bridge-piece, whereby an electrical circuit including a series of variable contacts is constituted between the two members of the inclined rear support, substantially as described.

5. The combination, in a telephone-transmitter, of a conducting contact-surface carried by a vibratory diaphragm, a rear conducting-surface inclined at an angle to the plane of the said diaphragm, a series of carbon disks constituting freely-movable contact-pieces supported peripherally upon the said inclined rear conducting-surface and caused thereby to abut against the diaphragm conducting-surface, the point of contact therewith being at or below the horizontal plane of their centers, the said disks being connected with an electrical circuit only by means of or through one or both of their supports, whereby their freedom of movement is unimpaired, and whereby they are enabled to rotate and to continually bring new points of contact into action, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 16th day of February, 1889.

BRUNO ABDANK-ABAKANOWICZ.

Witnesses:
THOMAS D. LOCKWOOD,
GEO. WILLIS PIERCE.