No. 665,639. Patented Jan. 8, 1901.

T. IWATA.

TELEPHONE TRANSMITTER.

(Application filed Oct. 25, 1899.)

(No Model.) 2 Sheets—Sheet 1.

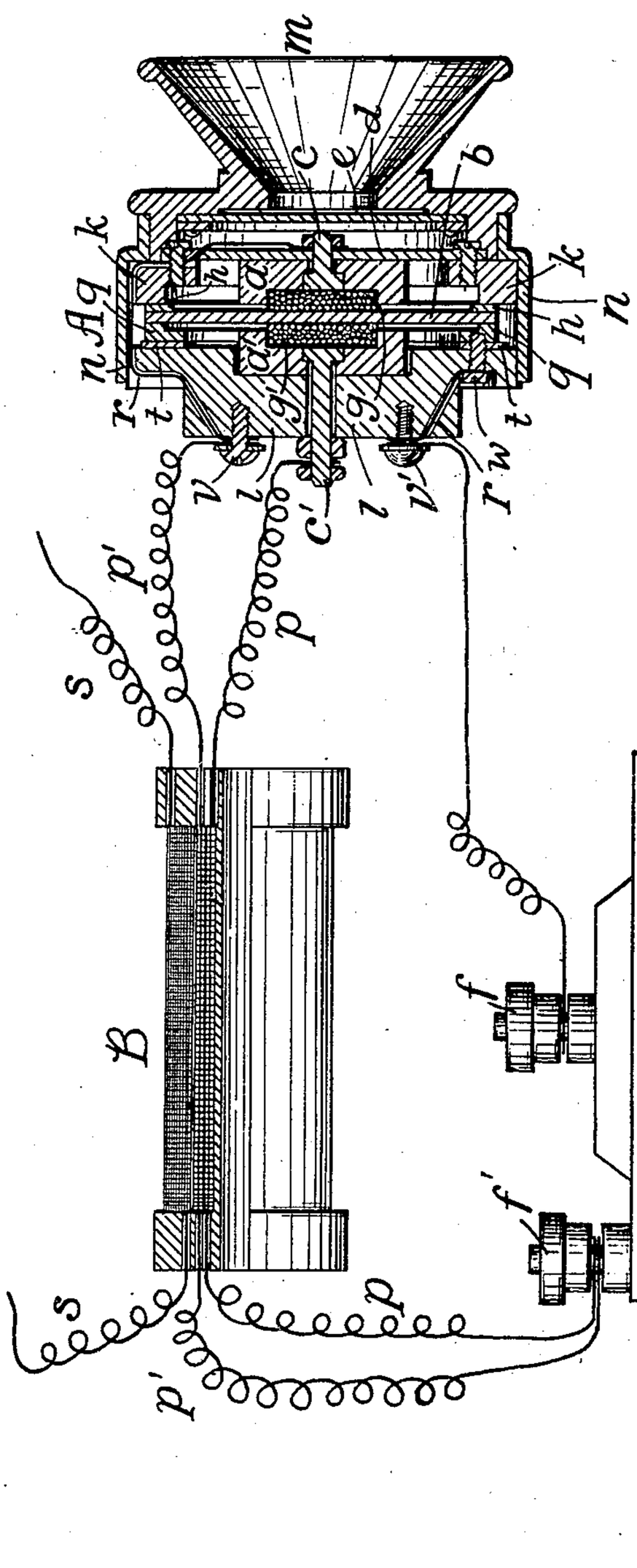

Fig. 1.

WITNESSES:

Yasuburo Fukushima

Rikitaro Miura

INVENTOR

Takeo Iwata

BY

Jokichi Takamine

ATTORNEY.

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Fig. 2.

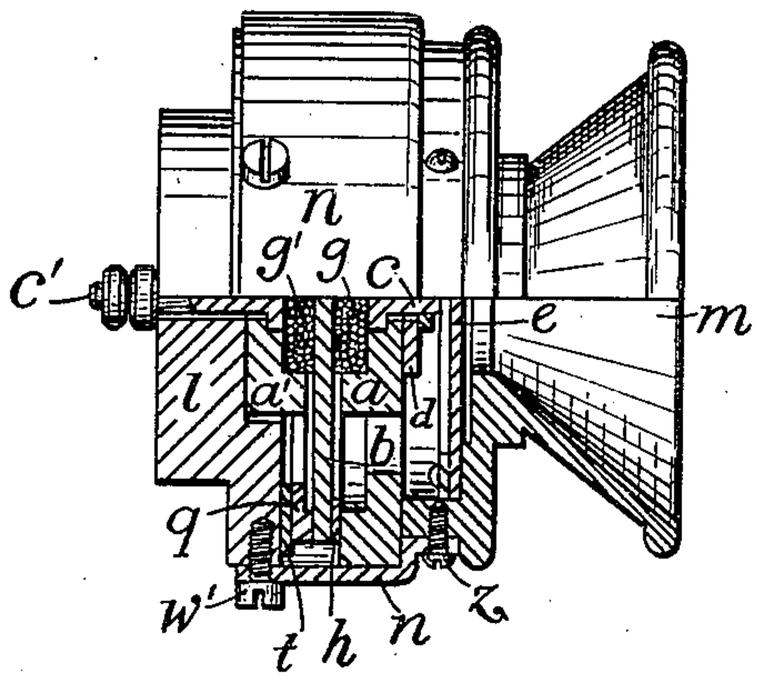
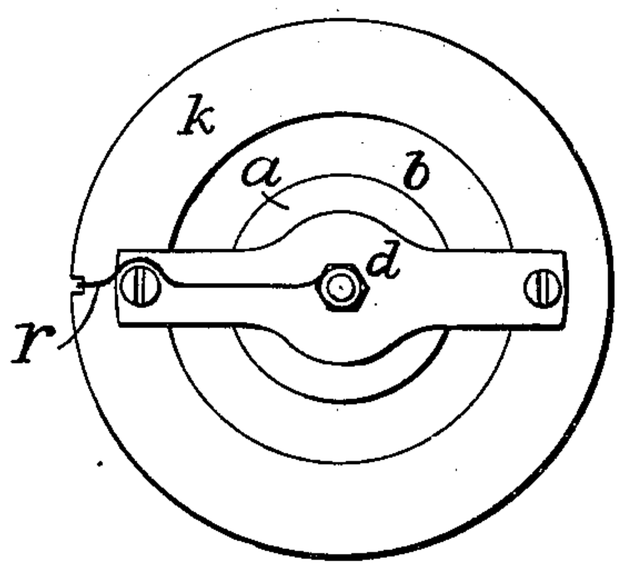


Fig. 3.



WITNESSES:

Yasuburo Fukushima

Rikitaro Miura

INVENTOR

Takeo Iwata

BY

Jobichi Takamine

ATTORNEY.

UNITED STATES PATENT OFFICE.

TAKEO IWATA, OF TOKIO, JAPAN.

TELEPHONE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 665,639, dated January 8, 1901.

Application filed October 25, 1899. Serial No. 734,894. (No model.)

To all whom it may concern:

Be it known that I, TAKEO IWATA, a subject of the Emperor of Japan, residing in the city of Tokio, in the Empire of Japan, have invented certain new and useful Improvements in Telephone-Transmitters, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to electric telephone-transmitters, and more particularly to that class of the microphonic transmitters which employ a body or bodies of granular or subdivided conducting material, like carbon; and the chief object of my invention is to provide a transmitter capable of producing louder and clearer sounds in the receiver than are produced by transmitters now in use.

A further object of my invention is to afford a protection to the diaphragm and the coöperating bodies of conducting material against the deteriorating effects of acids and moisture present in or condensed from the air or the speaker's breath.

To these ends my invention consists of the parts and combinations and arrangements of parts hereinafter described, and the novel feature thereof will be particularly pointed out in the appended claims.

In the accompanying drawings, Figure 1 is a general view of my invention, showing my improved transmitter and induction-coil and a source of electric energy in the form of a voltaic cell. Fig. 2 is a partly-sectional view showing a part of the exterior and a half-section of the said transmitter, taken at a right angle to that shown in Fig. 1. Fig. 3 is a front view of the transmitter with the mouthpiece and the outer casing removed.

In the figures the same symbols refer to the same parts.

The transmitter embodying my invention consists, essentially, of a set of microphones arranged on both sides of the main or working diaphragm, adapted to work in coöperation with the induction-coil, which forms another essential part of my invention, and a means to protect the operative parts from mechanical and other injuries, in combination with a means to rectify the vibrations of air which are caused to act upon the said diaphragm.

The induction-coil which I employ in carrying out my invention consists of a primary, composed of two oppositely-wound parallel coils, and a common secondary, and in coöperation with the aforesaid transmitter is adapted to induce in the said secondary a current of substantially double the amount of that which is induced in the corresponding secondary of the ordinary induction-coil of practically the same size.

Reference being now had to the drawings, A designates the transmitter, in which *m* is the mouthpiece, suitably secured to the outer casing *n*, the rear end of which is closed by means of the bottom piece *t*. A ring *k*, formed with an inner projecting flange, is arranged on the back of the innermost edge of the mouthpiece, all of the above-mentioned parts being made of ebonite or like material. Next to this ring *k* is a flat paper ring *h*, another paper ring being provided between the inner face of the bottom piece *t* and a brass or other metallic ring *q*, of similar shape as the flanged ring *k*, but reversed in position and also provided with an inwardly-projecting flange. Interposed between the paper ring *h* and the flanged metallic ring *q* is located the main or working diaphragm *b*, of carbon. Thus it will be seen that the diaphragm *b* is held in its operative position between the pairs of rings *k*, *h*, and *q* and the second paper ring, which are firmly clamped in turn between the mouthpiece *m* and the bottom piece.

The containers *a a'* consist of carbon and are substantially in the form of shallow cups, each adapted to hold a quantity of granular or subdivided carbon *g g'* between it and the diaphragm *b*. The said container or cup *a a'* is partly filled with a mass of granular carbon and is conveniently supported in a close proximity, but not in contact with, and in alinement with the center of the main diaphragm *b* by means of the screws *c c'*, respectively. The screw *c* is provided with a nut and passes through the cup *a* and metallic bridge-piece *d*, which in turn is secured by means of the screws passing through the same into the flanged ring *k*, thereby firmly clamping the cup *a* between the screw-head and the nut. The other screw *c'* similarly passes through the cup *a'* and the bottom piece *t*, thereby clamping the parts together.

At convenient places, as on the bottom piece, I provide two binding-screws *v v'* for

connecting the microphones with the transmitter-circuits. The screw *c* also constitutes another binding-screw for one of the transmitter-circuits, serving the double purpose of holding the cup *a'* in place and conveniently effecting the necessary connections. Thus it will be seen that there are three terminals provided in this transmitter.

It is important for the proper working of the transmitter that the cross or bridge piece *d* should be given a sufficient rigidity to afford a solid support for the cup *a*, so that any tendency of the cross-piece *d* to respond to the vibrations of the surrounding air is positively prevented. It is also desirable that the thickness of the paper rings used should be about one-fourth the diameter of a single grain of the carbons used.

At a distance apart from the front cup *a* and in close proximity with the contracted portion of the mouthpiece *m* is a thin membrane *e*, constituting in conjunction with the inner surface of the mouthpiece an annular clearance-space, such as is usually found in the telephone-mouthpiece. This membrane *e* is made of a soft, flexible, non-porous, and acid-proof material, as india-rubber, and is held very loosely stretched by any suitable means, such as the ring and screws indicated in the drawings, thus tightly closing the front of the casing A.

The construction of the induction-coil I employ in connection with the transmitter above described is similar to that of the ordinary forms, except in the manner of winding the primary coils. In my induction-coil B the primary coils consist of two distinct circuits *p p'*, which are oppositely wound to each other—that is, one of the primary circuits, as *p*, is wound in the right-hand way, while the other, as *p'*, is wound in the left-hand way. These two primary circuits differ from each other only in the direction of winding, and consequently of the current which may traverse through them; but in all other respects they are made as similar as possible—*i. e.*, they are wound of wires of the same kind and size and have the same number of turns.

Inasmuch as the other particulars of constructions of my induction-coil being substantially the same to that of the ordinary coil of this kind and also in view of the fact that the accompanying drawings clearly indicate such other parts not hereinbefore mentioned, I have not deemed it necessary to describe any further points in the construction. I will now proceed to describe the circuit connections of my invention.

Referring to Fig. 1, in which the source of electric energy is represented in the form of a voltaic cell, one end of the primary coil *p'* is connected with one of the terminals *v* of the transmitter, which is in electrical connection with the front cup *a* through the conductor *r* and the screw *c*. One end of the other primary coil *p* is connected to the terminal *c'*, which is electrically connected to the rear cup *a'*, as shown. The other ends of these two primary coils are both connected to a pole *f* of the voltaic cell, while the other pole *f'* of the same source of electric energy is connected with the remaining terminal *v'*, which is connected to the diaphragm *b* through the conductor *r*, the screw *w*, and the metallic ring *q*. The secondary *s* of the induction-coil is connected to the telephone-lines in a well-known manner.

From the foregoing description of the construction of the parts it will be easily seen that whenever the transmitter is used the sound is directed by the mouthpiece to meet with the very loosely-stretched membrane *e*, which transmits the necessary vibrations of the sound to the volume of air confined in its back, thereby setting the diaphragm *b* in vibration, the amplitude and frequency of which correspond with those of the sound directed upon the membrane *e;* but the latter absorbs and dampens that portion of the movements of air which does not enter into the constituents of the sound vibrations proper, but which has been created by an unavoidable disturbance of the external air, as by the air-draft or by the pressure of the user's breath. Hence in this manner the membrane *e*, which is very loosely stretched across the back of the mouthpiece proper, acts as a regulator or damper of all such unnecessary disturbance of air which would otherwise interfere with the purity of the vibrations received on the diaphragm *b*. It is important to note in this connection that the advantage of this membrane is not limited to the particular form of transmitters described, but is alike of great use for any type of electric telephones where the delicate parts arranged behind the mouthpiece are to be protected. I am thus enabled to deaden such heretofore unavoidable element of objection in telephone-transmitters which interferes with the production of a clear and distinct articulation in the receiver. Now when the diaphragm *b* receives the sound vibration the two masses of granular carbon *a a'* are affected to change their resistance. Thus if the diaphragm *b* is moved toward the cup *a'* the mass of carbon *g'* contained therein is compressed, thereby decreasing the resistance of the circuit including the voltaic cell, carbon grains *g'*, and a primary *p;* but simultaneously as this takes place the carbon grains *g* in the cup *a* on the opposite side of the diaphragm *b* are partly released from the compression previously exerted upon them, thereby increasing the resistance of the circuit through the voltaic cell, carbon grains *g*, and the other primary *p'*, and vice versa, when the diaphragm moves in the opposite direction. In this manner each time the diaphragm *b* is set in vibration the resistance in one or the other of the primary circuits is increased, and consequently the current traversing the same is decreased, while the resistance of another primary is simultaneously decreased and the current therein is in-

creased. The effect of this simultaneous increase and decrease of current in the two primary circuits will be to set up in the secondary circuit two distinct induced currents in one or the other direction. Were it not for the fact that the said two primary circuits are wound oppositely to each other the two induced currents would be in the opposite direction and counteract upon each other, and the effect produced in the secondary will be nil; but the two primaries are oppositely wound, as hereinbefore mentioned. Hence the direction of the induced current in the secondary by one or the other primary will be reversed and will take the same direction as the other. The induced current in the secondary will therefore be greater than and will be about double that which may be induced in the secondary of the usual induction-coils of the same size working in connection with the ordinary transmitters, and the receiver being thus acted upon by a current of increased intensity the volume of the sound reproduced will be correspondingly greater.

The foregoing will make it sufficiently clear in what manner I have been enabled to reproduce a louder sound in the receiver than has heretofore been possible. This result coöperating with the superior distinctness of articulation, made possible by the carbon grains on both sides of the diaphragms and the membrane inside of the mouthpiece, immensely improves the sound reproduced by the receiver under their combined action.

While I have illustrated and described a particular form and arrangement of my invention, I do not desire to restrict myself to the precise details of constructions shown, for it is evidently possible to effect several modifications and variations which will as a whole come within the scope and objects of my invention.

Having now particularly described the nature of my invention and in what manner the same is to be practiced, what I claim as new and useful, and desire to secure by Letters Patent of the United States, is as follows:

1. In a telephone-transmitter, a mouthpiece, a device for creating voice-currents, a membrane stretched beyond and parallel with the rear surface of the said mouthpiece, so as to leave an annular clearance, and without touching any part of the said device, substantially as described.

2. In a microphonic transmitter, a diaphragm, a set of microphones, one on each side of said diaphragm, and each consisting of a carbon-cup containing a loose mass of granular carbon, with its open end opposite to the respective sides of the diaphragm, on which said mass of carbon exerts a light pressure, whereby each of the said microphones is caused to vary its resistance simultaneously with the opposite variation in that of the other.

3. In a microphonic transmitter, a combination of a mouthpiece, a principal diaphragm, a set of microphones, one on each side of the principal diaphragm, and each consisting of a carbon-cup containing a loose mass of granular carbon, with its open end opposite to the respective sides of the diaphragm, on which the said mass of carbon exerts a pressure, a membrane interposed between the mouthpiece and the front end of the microphones, substantially as described.

4. In a microphonic transmitter, a combination with a casing, of a carbon diaphragm arranged within the said casing, of cups of carbon arranged in close proximity with the said diaphragm and partly filled with granular carbons, whereby the carbon grains in both cups will, when the latter are in operative position, lightly press on both sides of the diaphragm and complete the circuit through the bottom of cups and the said parts, and a mouthpiece covering the said casing and a diaphragm, tightly closing the casing and thereby excluding the external air from the diaphragm, a source of electricity, two oppositely-wound primaries of an induction-coil, through which the said cups are connected with one pole of the said source of electricity, the other pole of the latter being directly connected with the said diaphragm, substantially as described.

TAKEO IWATA.

Witnesses:
YASUBURO FIRKUSHIMA,
RIKITAVO MINOA.