No. 854,025. PATENTED MAY 21, 1907.

R. C. BROWNE.

TELEPHONE TRANSMITTER.

APPLICATION FILED APR. 25, 1906.

Fig. 13

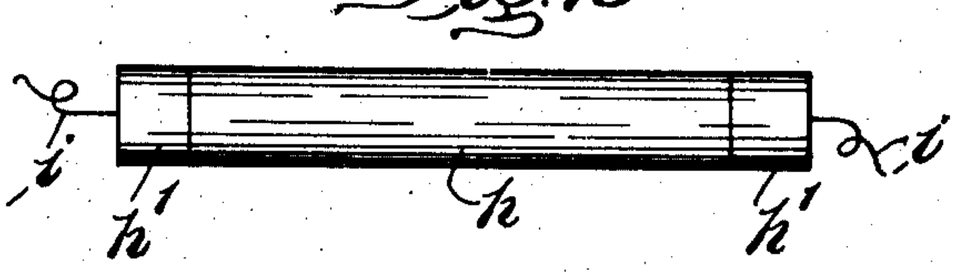


Fig. 10

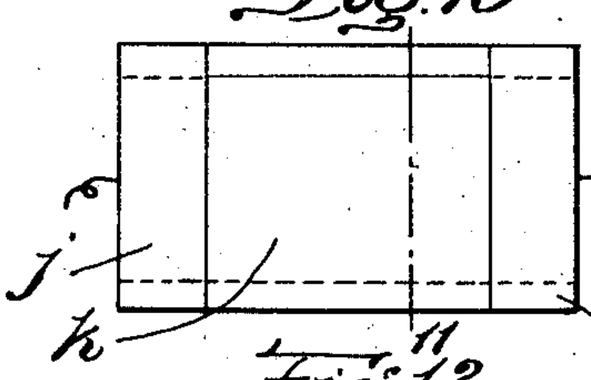


Fig. 11

Fig. 14

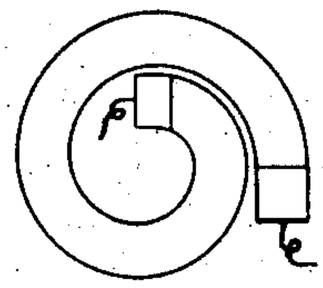


Fig. 12

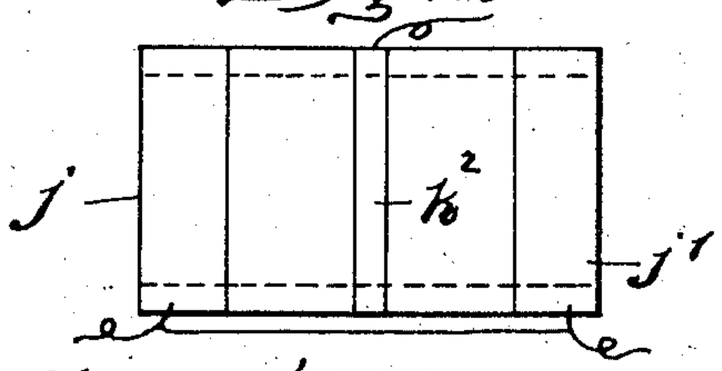


Fig. 3

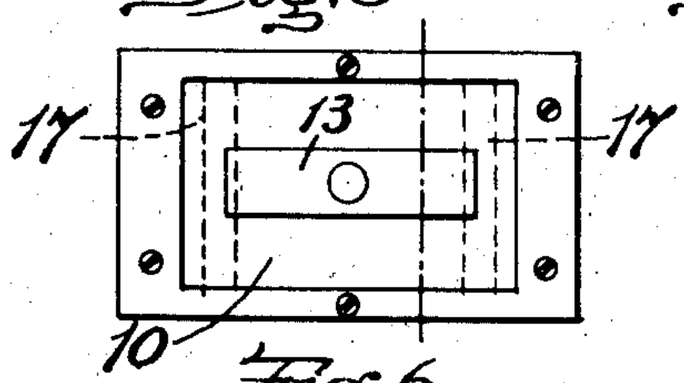


Fig. 4

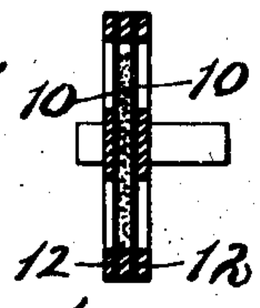


Fig. 5

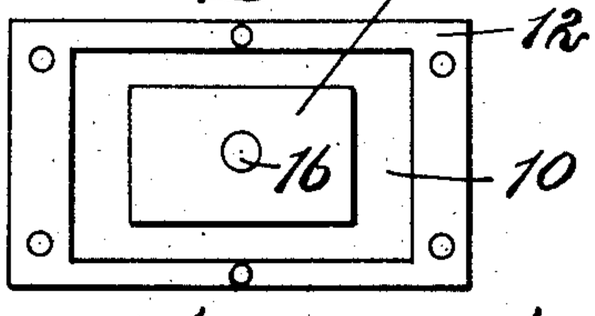


Fig 6

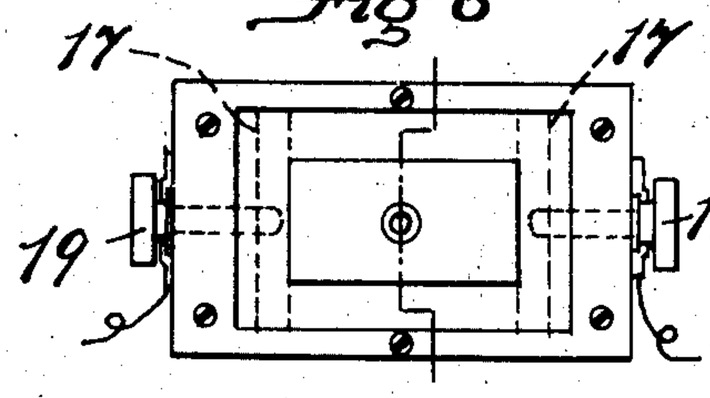


Fig. 7

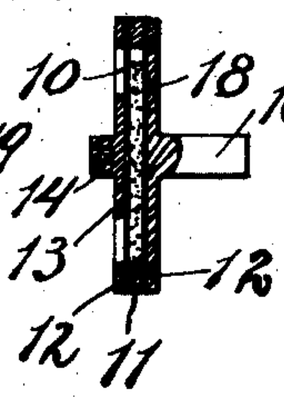


Fig. 8

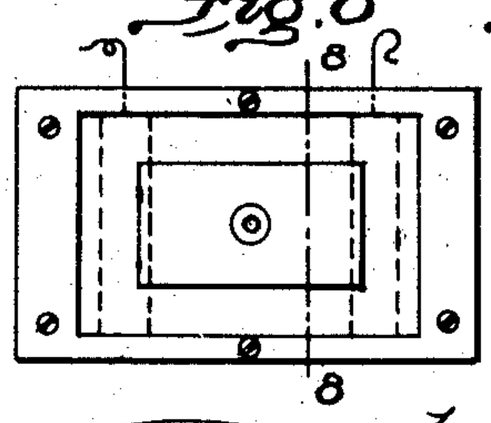


Fig. 9

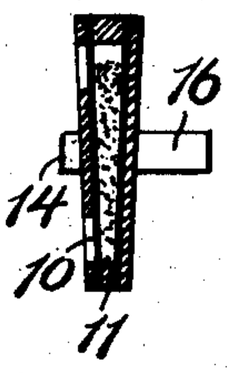


Fig. 1

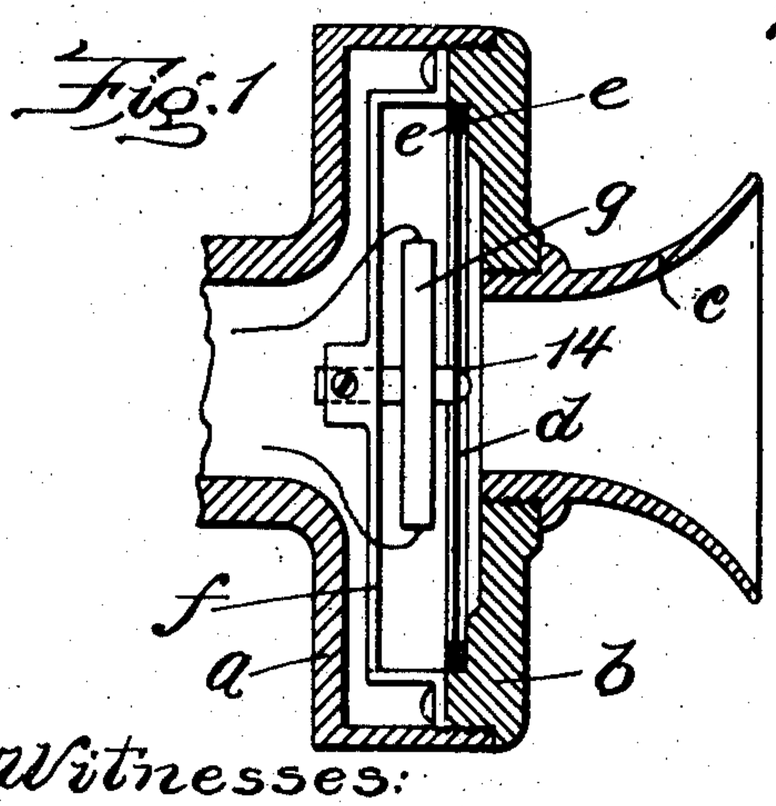
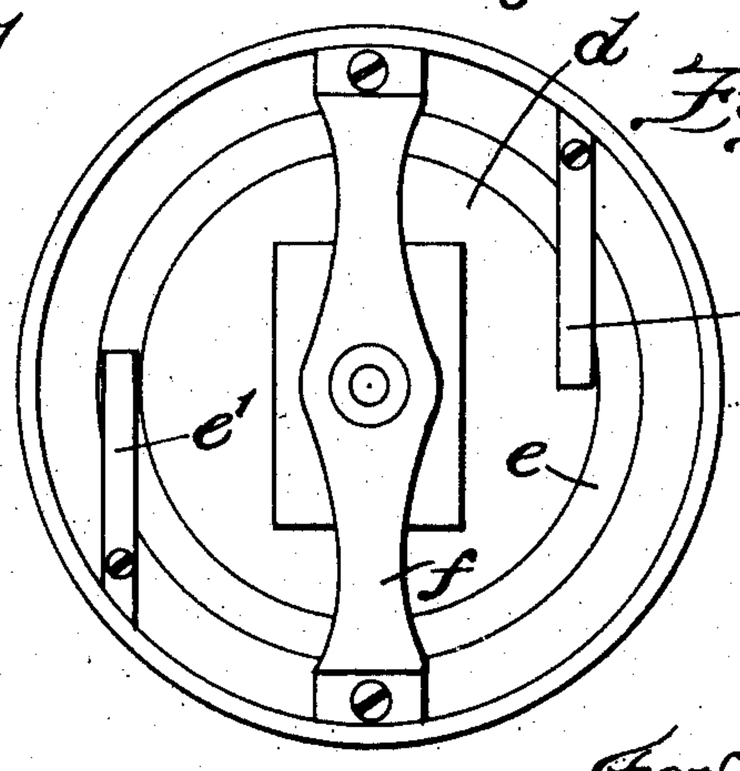


Fig. 2



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UNITED STATES PATENT OFFICE.

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TELEPHONE-TRANSMITTER.

No. 854,025. Specification of Letters Patent. Patented May 21, 1907.

Application filed April 25, 1906. Serial No. 313,578.

To all whom it may concern:

Be it known that I, RALPH C. BROWNE, of Salem, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Telephone-Transmitters, of which the following is a specification.

This invention has relation to telephone transmitters, to wit, those instruments which are designed to cause an electric current or currents to vary in intensity in synchronism or unison with sound waves.

The object of the present invention is to provide certain improvements in such instruments; first, for increasing their power to vary an electric current, and, second, to render the instrument capable of remaining in permanent operative condition.

As heretofore constructed, telephone transmitters have usually included a series of electrodes arranged in such manner that one of them may be moved against the other with more or less pressure, or both electrodes moved toward and from each other, so as to vary the conductivity of a variable conductor arranged in the transmitter circuit. In some of the instruments now in use, a space is left between the electrodes to contain a suitable mass of granular carbon or equivalent material, so arranged that any motion of either electrode causes more or less pressure to be brought against it. This variation in pressure gives rise to a so-called microphonic effect, or, in other words, a variation of resistance or conductivity which results in decreasing or increasing the current in the transmitter circuit. These instruments, as heretofore constructed, have several inherent defects. The low resistance of the variable conductor requires the employment of a current of low power, and further, owing to the ratio of the low resistance to the high resistance of the line, the range of variation effected by the variable conductor is necessarily limited. It would seem, at the first thought, that the defect could be overcome by separating the electrodes to a considerable distance and using a larger amount of granulated carbon. Experience shows that this does not remedy the evil, for the pressures generated by the sound waves impinging upon a diaphragm are necessarily weak, and consequently, with a large mass of granulated material, the pressure applied to one electrode is not transmitted uniformly through the mass of material, and consequently a very uneven action is the result. Another evil, which is found in transmitters, as heretofore constructed, is what is known as "packing"—that is to say, a settling down of the granulated material between the electrodes which prevents their movement. It has been attempted to overcome this evil by highly polishing the electrode, for the packing of the granular material is annoying and deleterious to the action of the instrument. It is possible that this packing is aided by what may be a cohering of the granular particles to the surface of the electrode under the action of the passing current.

I have discovered that by causing the electric current to traverse the granulated carbon or other active material which is used, in a line substantially transverse to the line or lines of pressure as applied by the vibrating diaphragm, I am able to greatly increase the microphonic effect and utilize an electromotive force much higher than has heretofore been found practicable. By causing the current to pass at substantially right angles to the lines of pressure, several important results are secured. The resistance of the mass of granular carbon may be increased to any desired quantity without interfering with the evenness of the pressure applied to the granules of carbon, since said carbon may be arranged in a comparatively thin layer and held between polished walls of non-conducting material such as mica or the equivalent. Since the retaining walls may be made very smooth and are free from any electric action on the particles of carbon, I am enabled to use a comparatively wide layer of carbon which will not pack, and which, owing to its extreme thinness, is able to carry a comparatively large amount of current without heating, since the thin retaining walls quickly radiate any heat that is generated. The pressure is applied to the active material by transmitting it from the diaphragm to one or both of the retaining walls to cause them to vary their position with relation to each other.

It will be understood that the invention is capable of a great variety of embodiments, those forms illustrated upon the drawings being some of those in which I have embodied it.

Figure 1 represents in vertical section a

complete transmitter embodying the invention. Fig. 2 represents a rear view of the same with the back part of the casing removed. Fig. 3 represents the chamber or member which contains the variable conducting material. Fig. 4 represents a vertical section through the same. Fig. 5 represents a rear elevation of the same. Figs. 6 and 7 represent another form of chamber or member embodying the invention. Figs. 8 and 9 represent another form in which the containing chamber is made V-shaped. Figs. 10 to 14 represent other forms of containing chamber or member embodying the invention.

Referring to the drawings, I have shown in Figs. 1 and 2 a transmitter, the casing of which comprises the cup *a*, a front plate *b*, and a mouth piece *c* screwed into an aperture therein. The plate *b* is hollow at its back to leave an air space between it and the diaphragm *d*, which is held against the plate by springs *e' e'* secured to the edge of the plate as shown. The usual gaskets *e e* are utilized in this construction. Back of the diaphragm and at a suitable distance therefrom, is placed a rigid cross bar *f* secured to the back of the plate *b* outside of the diaphragm by any suitable means. Between the bridge *f* and the diaphragm, is placed a member *g*, which is usually called the "button." This member contains the variable conductor or variable resistance medium, which, in general practice, takes the form of granular carbon. This member may be made in a variety of ways to embody the invention. Its simplest form is shown in Fig. 13, in which case it consists of a thin flattened tube *h* having electrodes *h' h'* at its ends in electric contact with the granular material that is placed therein. The tube may be made of paper or any other non-conducting resilient or flexible material and is placed between the bridge and the diaphragm so that the lines of pressure from the diaphragm are transverse to a current flowing from one of the electrodes to the other. When sound waves impinge upon the diaphragm, it is caused to vibrate and its vibrations are mechanically communicated to the walls of the tube or member to cause a varying pressure to be brought upon the contained active material, whose resistance is thereby altered to allow more or less current to pass through the transmitter circuit. The terminals of the transmitter circuit, which are indicated at *i i*, are connected in any suitable way with the electrodes *h' h'*.

In Fig. 14, the tube is illustrated as being spiral to secure a greater length and high resistance, for it will be understood that the higher the resistance of the variable material, the greater the variation of resistance under pressure and the higher the electromotive force that may be used. These two forms of chamber or member may be used for inexpensive transmitters, especially on private country lines that would have a high resistance, for, by their use, the advantage of common battery systems may be obtained even though the member has to vary the resistance of a circuit of very high resistance. I have used them to vary the current in a circuit of approximately 25,000 ohms with success and have reason to believe that the current in circuits of a still higher resistance could as readily be varied by similar forms of the invention. It will be understood that the invention practically takes the place of both the induction coil and the transformer button heretofore employed.

In Figs. 10 and 11 is illustrated another embodiment of the invention in which the electrodes *j j'*, which may be of metal foil if desired, are fastened to the inside ends of two mica walls, attached to the outside of an insulating frame *k'*. The space between the walls and the sides of the frame forms a chamber for containing the active material. This element or containing chamber will be located approximately as illustrated in Fig. 1, and it is to be assumed that one wall will receive the vibrations of the diaphragm and that the opposite wall will be connected to a rigid abutment. It is quite apparent that I may employ more than two electrodes, as shown in Fig. 12, there being an electrode *k²* located midway between those at *j j'*, thus virtually producing microphones which, working together, are double the power of one.

Referring to Figs. 3, 4 and 5; the embodiment of the invention there illustrated comprises two resilient or flexible retaining walls 10 10, arranged substantially in parallelism, relatively close together, and secured to a hollow frame 11 of non-conducting material by frames 12 12. Preferably, although not necessarily, these walls are formed of mica which has a smooth surface. Between the walls 10 10 is placed the active material, which, as stated, preferably consists of granular carbon. To the front wall is secured, in any suitable way, a plate 13 having a boss 14, which may be secured by a screw to the center of the diaphragm *d*. To the rear wall is attached a similar plate 15 having a boss or pin 16 which is adjustably secured to the brace *f*. Electrodes 17 17 are arranged in the chamber at opposite ends thereof, as illustrated by dotted lines in Fig. 3, and are connected in series in the transmitter circuit. These electrodes may consist of platinum, gold, aluminium, carbon or any other suitable non-oxidizing material for making electrical contact with the active material.

Instead of making both walls of the chamber of flexible or resilient material, one of them may be rigid as illustrated at 18 in Fig. 7, although in this invention it will preferably be made of non-conducting material susceptible of having its surface highly polished.

Or, if desired, this plate or wall 18 may constitute one of the frames and serve as a solid abutment for a mica wall interposed between it and the active material. With the arrangement shown in Fig. 7, I may also employ adjusting screws 19 19 for adjusting the electrodes 17 17 toward and from each other to vary what I may term the normal resistance of the button.

In Figs. 8 and 9, I have illustrated a construction substantially similar to that shown in Figs. 6 and 7 except that the opposing walls of the button are arranged at an angle to each other to make a V-shaped chamber. With this construction it is practically impossible for the material to pack, since an exceptionally heavy pressure only tends to move the material up; when the pressure is removed, the material falls back in perfect working condition.

The operation of the devices illustrated in Figs. 3 to 9 will be understood from the previous descriptions. It may be stated, however, that in all of the forms of the invention which I have illustrated, the path of the current is transverse to the lines of pressure resulting from the movement of the diaphragm, and that the length of the path through the granular material is many times the thickness of the material. The pressure is not applied, as in ordinary instruments, by the electrodes, for on the contrary the electrodes are stationary relatively to each other, and the material is compressed between them by pressure applied on lines substantially perpendicular to the lines connecting said electrodes. It is quite apparent that two or more of the buttons, constructed in accordance with this invention, may be arranged on the same or on opposite sides of the diaphragm, or two or more of them may be adapted to be operated from one diaphragm, in consequence of which the transmitter may be used as a double instrument.

Although the invention is adapted for many uses, it lends itself especially to modern common battery systems, for, owing to the high resistance of the button, a great variation of the current flowing through it is effected to give even more powerful results than where a local battery and coil are used at the transmitting station. Conductors of high resistance, such as iron or steel, may be used in telephone lines, since the resistance of the button may be made very high as compared with the resistance of the line to cause the largest portion of the current in the line to be expended in the button. Hence the button is able to greatly vary the resistance of the electric circuit as a whole and govern to a considerable extent the amount of current flowing through it.

By reason of the particular construction of the button, the variations in the current are sharp and well defined, and, as the result, the articulation at the receiver is clear even though the circuit contains a considerable amount of resistance and capacity. This is doubtless due to the fact that the thinness of the layer of carbon granules enables the slightest vibration of the diaphragm to effect an even compression of the carbon, and also to the fact that the pressure against the carbon causes it to be forced endwise of the chamber against the electrodes with a varying pressure. The layer though thin, is lengthened between the electrodes to any desired extent, (as illustrated the length of the layer is many times its thickness) to increase its resistance so that the resistance of the button in a common battery system may be not much, if any, less than the total resistance of the line.

It will be understood that the invention is not limited to the details which I have illustrated and described.

Having thus explained the nature of the invention, and described a way of constructing and using the same, although without attempting to set forth all of the forms in which it may be made, or all of the modes of its use, I declare that what I claim is:—

1. A telephone transmitter, comprising confronting retaining walls of non-conducting material, one movable toward and from the other under pressure of sound vibrations, a thin layer of granular material between said walls, electrodes between said walls in contact with the granular material and separated a distance considerably greater than the thickness of said layer of granular material, all so arranged that the current flows from one electrode to the other through the granular material transversely to the line of pressure of the movable retaining wall thereon.

2. A telephone transmitter comprising a diaphragm, a thin layer of resistance material, electrodes in contact with said layer of resistance material and separated by a space much greater than the thickness of the layer, retaining walls of non-conducting material confining between them said electrodes and said layer of resistance material, and means for transmitting to one of the retaining walls the vibrations of said diaphragm, all so arranged that the current flows from one electrode to the other through the thin layer of resistance material transversely to the lines of pressure from the diaphragm thereon.

3. A telephone transmitter comprising confronting retaining walls of flat non-conducting material forming a thin space between them, at least one of said walls being flexible, a thin layer of resistance material in said space, electrodes less in thickness than said space located therein between the said walls, and separated a distance much greater than the thickness of said layer of material to

cause the current to traverse a relatively long path between them, said electrodes being embedded in or overlapped by said layer, all so arranged that the vibration of said flexible wall compresses said resistance material in lines transverse to the path of the current between said electrodes.

In testimony whereof I have affixed my signature, in presence of two witnesses.

RALPH C. BROWNE.

Witnesses:
MARCUS B. MAY,
A. L. FOLSOM.