E. GRISSINGER.

TELEPHONE TRANSMITTER.

APPLICATION FILED NOV. 18, 1911.

1,198,345.

Patented Sept. 12, 1916.

2 SHEETS—SHEET 1.

Fig. 3

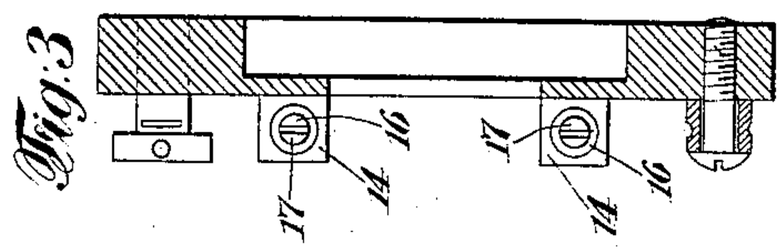


Fig. 2

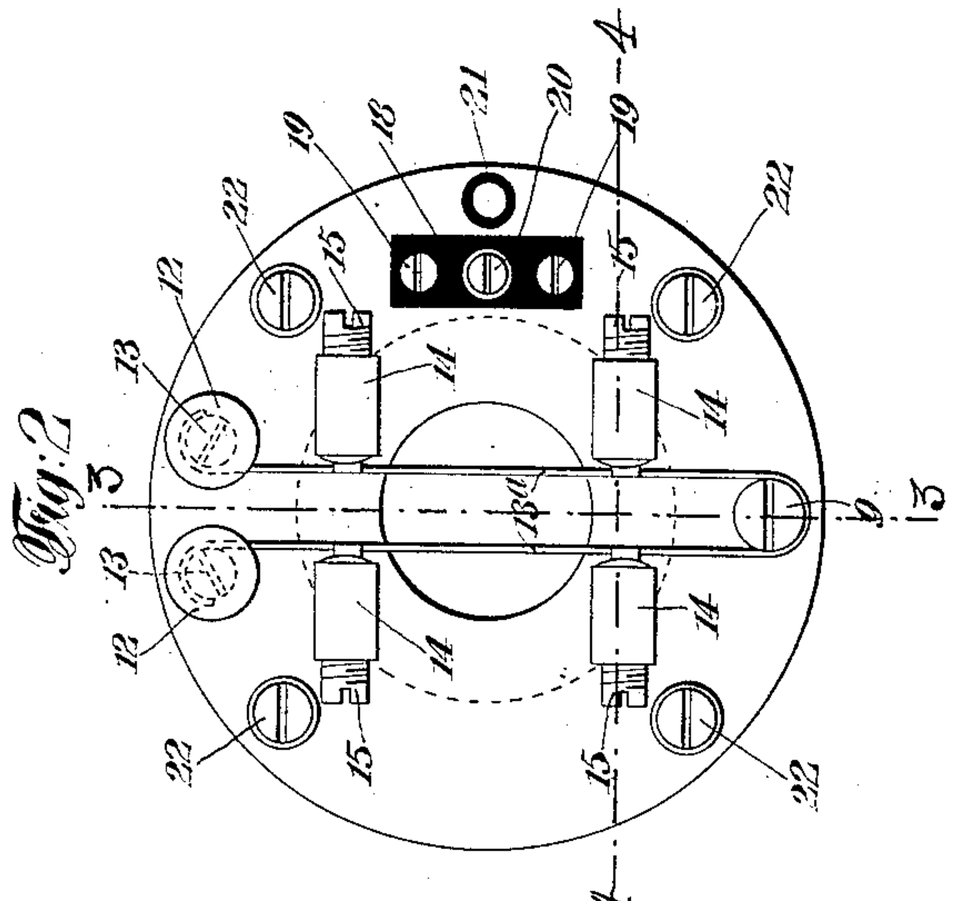


Fig. 5

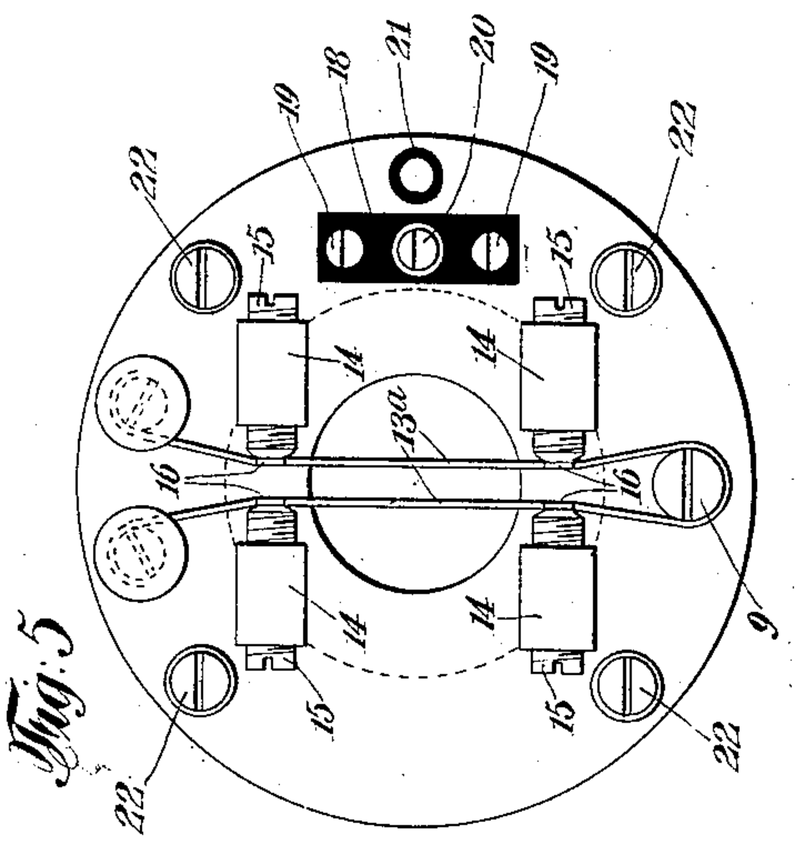


Fig. 1

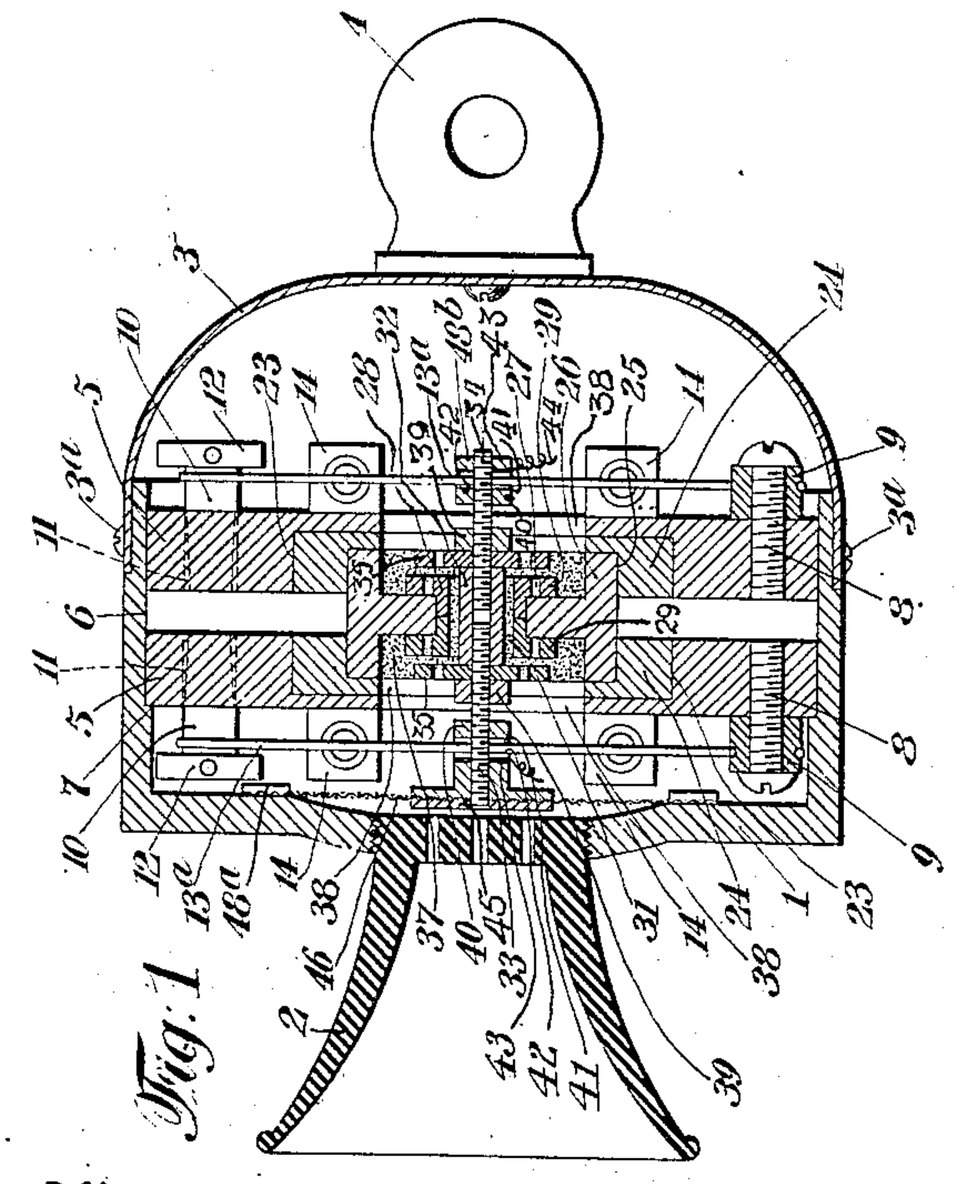
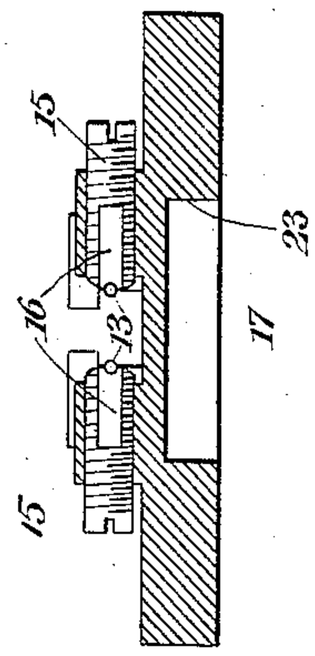


Fig. 4



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2 SHEETS—SHEET 2.

Fig. 9

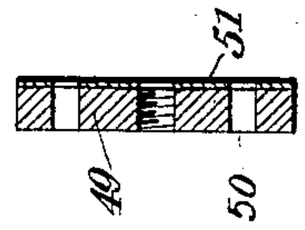


Fig. 8

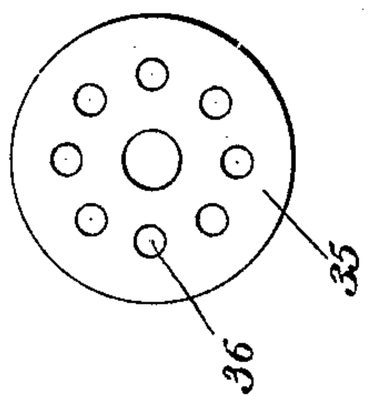


Fig. 10

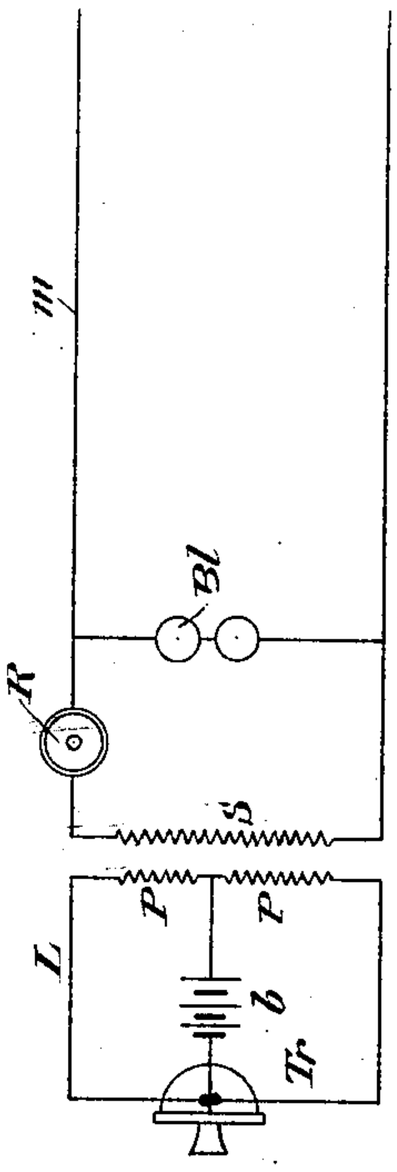


Fig. 7

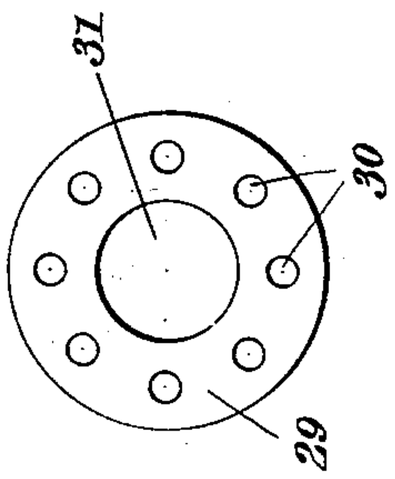
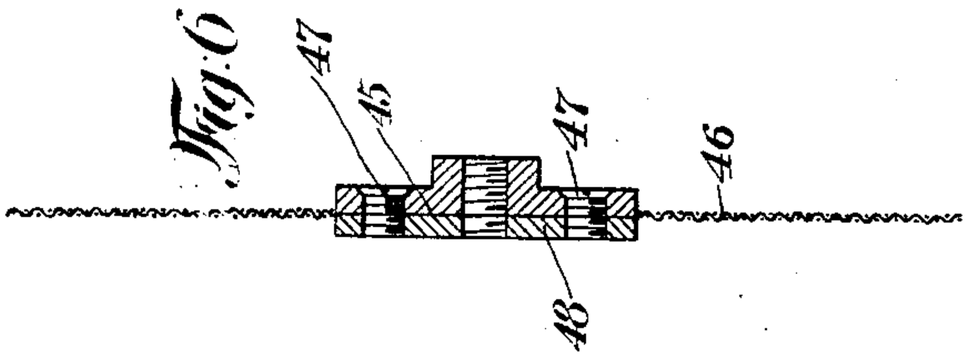


Fig. 6



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UNITED STATES PATENT OFFICE.

ELWOOD GRISSINGER, OF BUFFALO, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEPHONE-TRANSMITTER.

1,198,345. Specification of Letters Patent. Patented Sept. 12, 1916.

Application filed November 18, 1911. Serial No. 660,993.

To all whom it may concern:

Be it known that I. ELWOOD GRISSINGER, of Buffalo, in the county of Erie, and in the State of New York, have invented a certain new and useful Improvement in Telephone-Transmitters, and do hereby declare that the following is a full, clear, and exact description thereof.

The invention consists in an organization of parts in a telephone transmitter imposing upon the vibratory system thereof a high natural frequency which is sufficient to eliminate the effects of resonance and thereby improves the faithfulness of the conversion of voice waves into electrical waves. The vibratory system comprises the parts moved by the impinging voice waves which parts are made with the least possible mass consistent with mechanical strength and qualified as respects their bodily movement by connection with associated instrumentalities having a high degree of elasticity and a natural frequency high enough to bring the frequency of the whole above the point where resonance interferes with transmission.

In the accompanying drawings I have illustrated one form of embodiment of the said invention, in which—

Figure 1 is a cross-section of the transmitter case and the elements mounted therein; Fig. 2 is a plan view of one type of suspension ring; Fig. 3 is a cross-section of the same, taken on line 3—3; Fig. 4 is another cross-section of the ring shown in Fig. 2, but taken on line 4—4; Fig. 5 is a plan view of the same type of suspension ring, showing the suspension wires brought together by adjusting screws, and subjected to a tension beyond that which is given normally; Fig. 6 is a side elevation of a diaphragm used in this instrument; Fig. 7 is an elevation of one of the stationary electrodes; Fig. 8 is an elevation of one of the movable electrodes; Fig. 9 is a vertical section of a modified form of movable armature; and Fig. 10 shows a simple form of circuit arrangement in which my transmitter may be used.

In the drawings, 1 indicates an outer casing made of metal, which casing has attached to the front thereof a mouthpiece 2 which is screw-threaded into the casing 1. A cover 3 is attached to the rear of the casing 1 by means of screws 3^a, and attached to the cover 3 is an annular bracket 4 which is used to support the entire transmitter by being attached to any suitable support. Within the casing 1 there is located a pair of suspension rings 5 which fit within an annular recess 6 so that one of the rings 5 is adjacent to an annular shoulder 7 on the interior of the casing. Each of the rings 5 is provided at its lower side with a screw 8 which is screw-threaded into the ring and projects above the surface of the ring where it carries a hardened steel grooved roller 9. At the top the ring is provided with a pair of hardened steel tapered pins 10 fitting in corresponding recesses 11 in the rings, and provided at their outer ends with capstan heads 12. Each of the pins 10, furthermore, has a transverse aperture 13 to receive an end of a steel piano wire 13^a which extends around the roller 9, and has its ends attached to the two tapered pins 10 in the top of the ring. The outer face of each of the rings is provided with four projections 14, within each of which there is a screw-thread and adjusting screws 15. Each of the adjusting screws 15 has in its end an opening to receive a cylindrical hardened steel pin 16, having in its end a groove 17 to receive the wire 13^a. At one side of one of the rings 5, as indicated in Fig. 2, there is located an insulating plate 18 which is attached to the face of the ring 5 by means of screws 19. The plate 18 carries an electrical terminal post 20. Near the position of the plate 18, is located an insulating sleeve 21 passing through the ring 5 to receive the wire which is to be attached to the terminal post 20. The rings 5 are secured together by means of screws 22 which pass transversely to one of the rings and are screw-threaded into the other. The inner faces of the rings 5 are provided with circular recesses 23 to receive rings 24, said rings 24 being provided with similarly located recesses 25 to receive an annular casing 26 to act as a variable resistance medium chamber. The casing 26 has a central opening 27, into which are forced by pressure the flanges 28 of a pair of stationary electrodes 29. The electrodes 29 have a number of holes or apertures 30 in their faces to prevent the variable resistance medium from packing. When the stationary electrodes 29 have been placed in position, a central opening 31 is left passing from the front to the rear of the casing 26.

Passing through the opening 31 there is an insulating coupling 32 into the ends of which are screw-threaded two screw-threaded rods 33 and 34, one extending toward the front of the transmitter, and the other extending toward the rear thereof. These rods 33 and 34, together with the coupling 32, constitute a composite connector for the movable parts of the transmitter. The rods 33 and 34 carry adjacent to the coupling 32 a pair of movable electrodes 35 located on opposite sides of the casing 25 and spaced equal distances away from the stationary electrodes 29. The electrodes 35 are also provided with apertures 36 to prevent the packing of the bodies of variable resistance medium, preferably of granulated carbon, located within the casing 26.

The variable resistance medium 37 is retained in position on the opposite sides of the casing 26 by means of two mica diaphragms 38, which are supported on opposite faces of the casing 26 by being inserted between said casing and the recesses 25, in which it is received. A pair of nuts 39 are screw-threaded over the rods 33 and 34 adjacent to the mica diaphragms 38, to hold them tight against the outer faces of the movable electrodes 35. A pair of similar nuts 40 is also carried by the rods 33 and 34 at some distance away from the nuts 39, these nuts 40 receiving on their outer faces a pair of mica washers 41 against which the wires 13ª are designed to rest. The rods 33 and 34 beyond the wires 13ª carry a similar pair of mica washers 42 and the rods carry beyond the mica washers 42 a pair of annular terminals 43 to which are attached wires 44, leading to the local circuits which include the telephone transmitter. At the front of the transmitter the rod 33 has screw-threaded thereto an armature type of diaphragm 45, which holds the mica washers 41 and 42 and the terminal 43 in position. Screwed to the front of the armature diaphragm 45 is a disk of moisture-proof fabric 46 which is secured to the outer face of the armature diaphragm 45 by means of screws 47 passing through an outer plate 48 and through the fabric 46 and into the armature diaphragm 45. The armature diaphragm 45 shown in Fig. 6 is somewhat thicker than the armature diaphragm shown in Fig. 1. The disk of fabric 46 is attached at its outer edge to the inside of the casing 1 by means of a clamping ring 48ª. At the rear of the transmitter the terminal 43 and the mica washers 41 and 42 are maintained in position by means of a nut 48ᵇ.

As shown in Fig. 9, I may make use of another type of movable electrode which comprises a main portion 49 made of magnalium having apertures 50 and having a backing 51 of any ordinary type of metal, such as brass or copper, which may be, if desired, plated with platinum or osmium-iridium.

In Fig. 10, I have shown a simple form of circuit arrangement, in which my transmitter may be used. In this figure, Tr. indicates the transmitter, *b* indicates the battery of the local transmitter circuit L, *p*, *p*, indicate the primaries of the induction coil located in said circuit, *s* indicates the secondary of said induction coil which is located in the main circuit *m*, said circuit also including the receiver R, and a bell B*l* bridged across the main line *m*.

The operation of my transmitter is briefly as follows: Sound waves coming into the mouthpiece 2 impinge upon the armature diaphragm 45, thereby communicating vibratory movement to the movable electrodes 35 which are supported upon the system of wire suspension including the wires 13ª above described. As a result, differences in the conductivity of the variable resistance medium 37 contained within the casing 26 are produced, thereby producing corresponding variations in the local circuits L. These variations in conductivity of the variable resistance medium are such that when the conductivity of the variable resistance medium in one side of the variable resistance medium chamber is increased, the conductivity on the other side thereof is correspondingly decreased. Inasmuch as these two halves of the body of the variable resistance medium are contained in two separate portions of the local transmitter circuit, and inasmuch as the primaries of the induction coil which are affected thereby are wound in opposite directions, the equal and opposite effects produced in the variable resistance medium chamber have the same effect upon the secondary *s* of the induction coil. Not only is this the case, but the effect produced by the two halves of the variable resistance medium is then twice the effect which could be produced by one variable resistance medium alone, corresponding to one half of the body of variable resistance medium contained within the variable resistance chamber. The use of the type of vibratory member against which the sound waves impinge, insures a complete bodily movement of such parts. There are no unequal stresses or graded portions of a diaphragm which vibrate. A maximum sensibility is reached with due regard for the fundamental frequency, when the mass of the moving parts is reduced to the lowest practicable limit. To acquire this condition, the threaded rods 33 and 34 are made of aluminum or one of its alloys, such as magnalium. The electrodes 29 are made of the same metal and electroplated with platinum or other non-corrosive substance. The suspension wires 13ª may also be made of a magnalium alloy.

With a view to decreasing the mass of the vibratory parts it is found desirable to reduce the section of such medium and thereby the quantity of the granular carbon. I have found that the spacing between adjacent faces of electrodes should be about $\frac{1}{32}$ of an inch. With this shallow spacing the effect of heat exansion upon the granular carbon upon each side of the instrument becomes more pronounced owing to bringing the particles of carbon into more intimate physical contact. It is for this reason that I have provided circular apertures in the faces of the electrodes, which apertures serve as pockets into which the granular carbon can expand as a result of the small heating effect occurring in the active zone.

The pins 10 with the capstan heads 12 constitute a primary means for tightening the wires 13ª of the wire suspension. The screws 15 constitute a secondary means for increasing the tension thereof beyond that which can be obtained by the pins 10 alone.

Fig. 5 shows the position of the wires 13ª after increasing their tension and raising their fundamental frequency by means of the adjusting screws 15. This raising of the pitch of the vibratory system is done for the purpose of eliminating the effects of resonance. The raising of the pitch of the vibratory system is done for the purpose of elimiuating the effects of resonance and also to effect the transformation of sound waves into telephone current waves with the same relative ratios of loudness or with the same degrees of loudness if it is assumed that the initial degrees of loudness of all waves are the same. The pitch of the wires is raised to such a point that it will not be sensibly lowered by the mass and damping factor introduced by attaching the fabric 46, armature diaphragm 45, rods 33 and 34, electrodes 35, etc., to the wire suspension. Experiments with sensitive repeaters employing these principles prove conclusively that this result is accomplished. Other means to eliminate the effects of resonance are shown in my pending applications for telephone relays and repeaters.

While I have described my invention above in detail, I wish it to be understood that many changes may be made therein without departing from the spirit of my invention.

I claim:

1. In a telephone transmitter, the combination of a member upon which the voice waves impinge directly, a granular resistance material, electrodes in contact therewith, one of which is connected with said membe , and means independent of said member for imposing upon the same and the parts moving therewith a natural frequency above the resonating period of the voice waves to be transmitted, whereby the effect of the resonance of such vibrating parts is ineffectual to modify the transmission.

2. In a telephone transmitter the combination of a member upon which the voice waves impinge directly and which is unrestrained against vibration at its periphery, a variable resistance electrode connected to said member and means independent of said member for imposing upon the same and the parts moving therewith a natural frequency above the resonating period of the voice waves to be transmitted.

3. In a telephone transmitter the combination of a member of low mass upon which the voice waves impinge directly, a granular resistance material, electrodes in contact therewith, one of which is of light mass and connected with said member, and means independent of said member for imposing upon the same and the parts moving therewith a natural frequency above the resonating period of the voice waves to be transmitted.

4. In a telephone transmitter, the combination of a member upon which the voice waves impinge directly, a variable resistance electrode connected therewith, and means independent of said member for imposing upon the same and the parts moving therewith a natural frequency above the resonating period of the voice waves to be transmitted, said means comprising a wire suspension and tensioning means for putting the same under a degree of tension suited to accomplish the purpose just stated.

5. In a telephone transmitter, the combination of a variable resistance electrode, means whereby the same is vibrated by the voice waves and means for imposing a high natural frequency upon said electrode and the parts moving therewith, which means comprise a wire suspension having primary tensioning means for the wire thereof and independent secondary tensioning means for increasing the tension of said wire beyond that which can be obtained by the primary means.

6. In a telephone transmitter the combination of a variable resistance electrode, means whereby the same is vibrated by the voice waves, and means for imposing a high natural frequency upon said electrode, said means comprising two substantially parallel wires, a primary means for tightening such wires and a secondary means adapted to increase the tension thereof by lateral deflection.

7. In a telephone transmitter the combination of a variable resistance electrode, means whereby the same is vibrated by the voice waves and means for imposing a high natural frequency upon said electrode comprising a wire suspension, a primary means for tightening the same and a secondary

means for increasing the tension thereof comprising one or more screws having a bearing for the wire swiveled therein.

8. In a telephone transmitter the combination of a variable resistance electrode, means whereby the same is vibrated by voice waves and means for imposing a high natural frequency upon said electrode comprising adjacent wires, a primary tensioning means for such wires and means for deflecting such wires in their own plane.

9. In a telephone transmitter the combination of a member actuated by direct impingement of voice waves, a granular resistance medium, an electrode in contact therewith, and means in front and in rear of said resistance medium connected with said member and electrode, said means having a natural frequency which when loaded with said member and electrode imparts a natural frequency to the latter at or above the resonant period of speech.

10. A telephone transmitter comprising a vibratory element, a movable electrode attached thereto, a variable resistance medium actuated by said electrode, and means for balancing the electrode by means of oppositely-acting forces, comprising wire supports placed under tension by bowing.

In testimony that I claim the foregoing I have hereunto set my hand.

ELWOOD GRISSINGER.

Witnesses:
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