

R. F. RICE.
TELEPHONE TRANSMITTER.

No. 539,086.

Patented May 14, 1895.

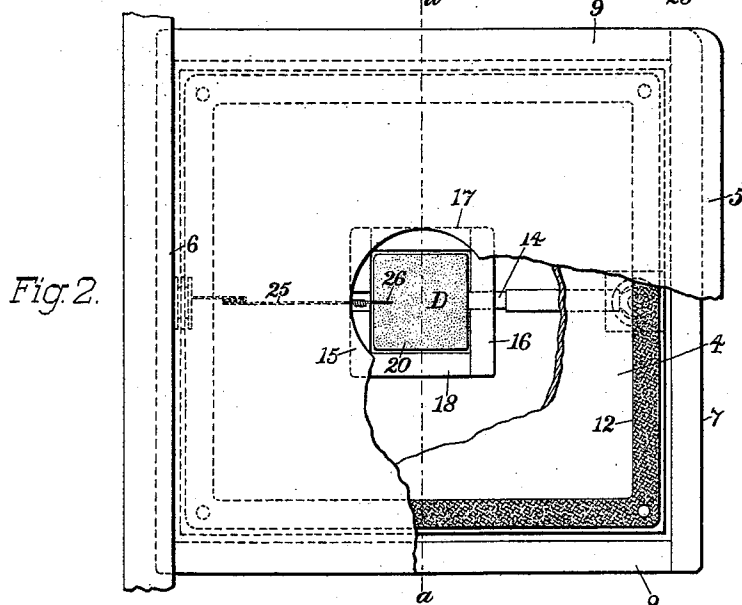
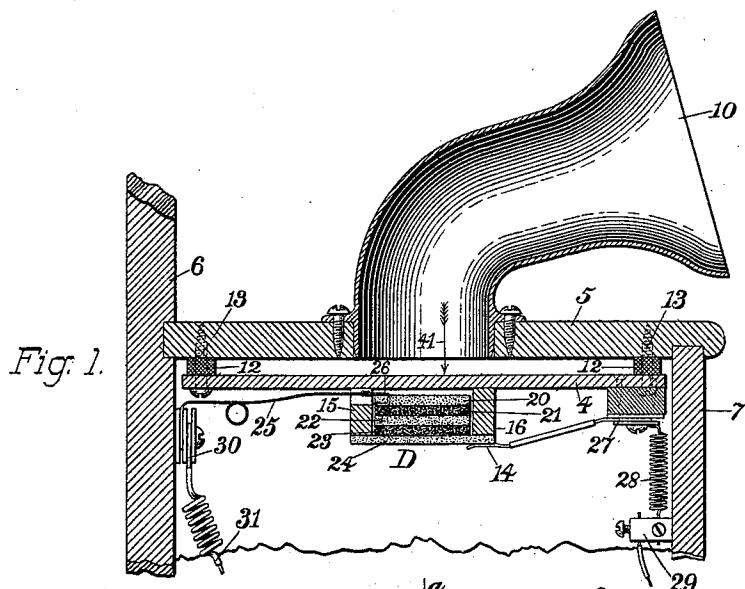
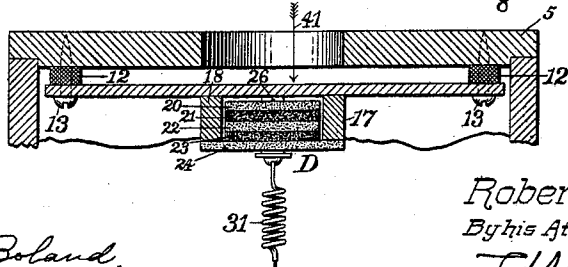


Fig. 3.



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Fig. 4.

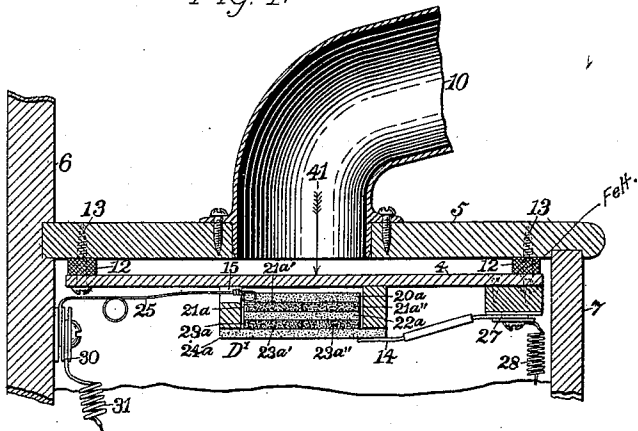


Fig. 9.



Fig. 10.



Fig. 11.



Fig. 12.



Fig. 13.

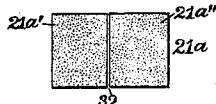


Fig. 14.

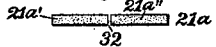


Fig. 15.

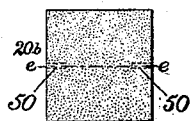


Fig. 16.



Fig. 5.

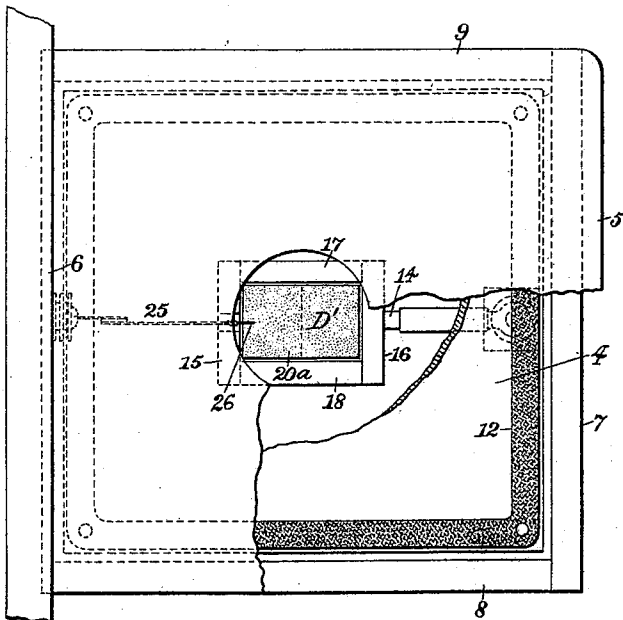
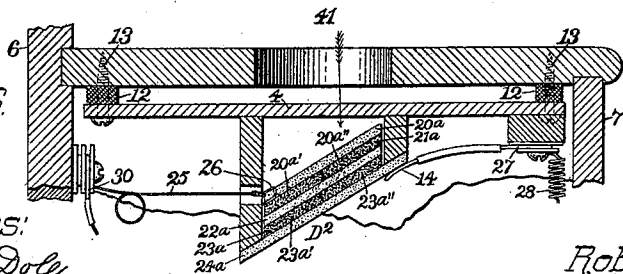


Fig. 6.



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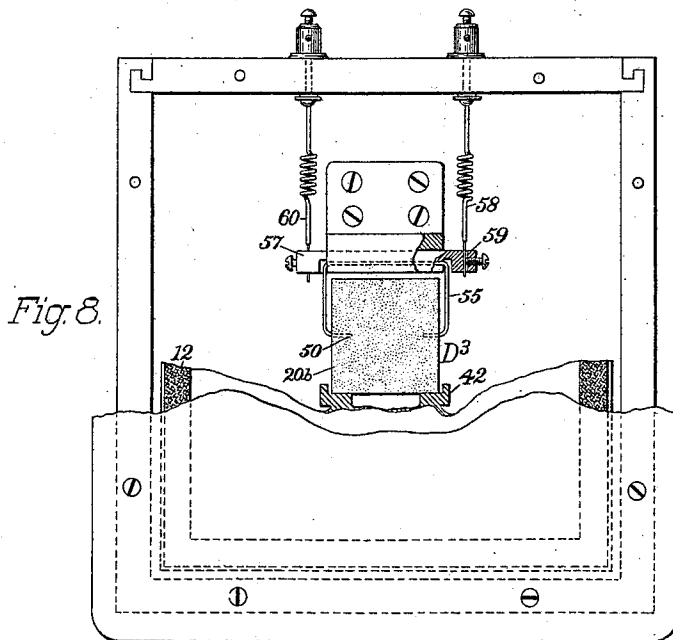
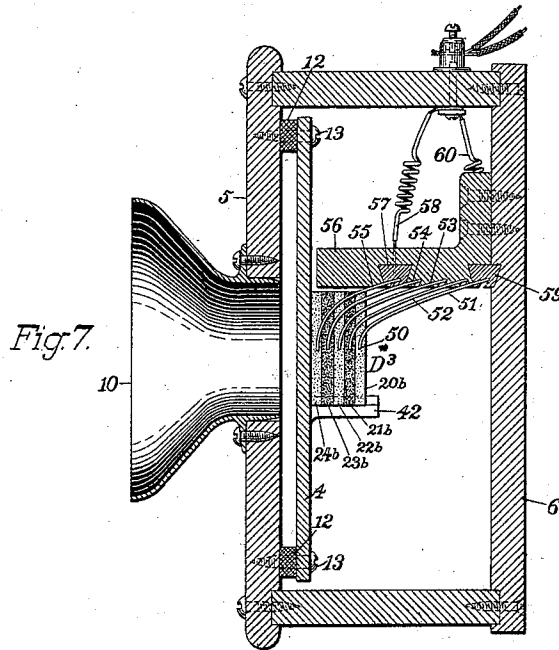
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UNITED STATES PATENT OFFICE.

ROBERT F. RICE, OF HARTFORD, CONNECTICUT, ASSIGNOR TO FRANCIS H. RICHARDS, OF SAME PLACE.

TELEPHONE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 539,086, dated May 14, 1895.

Application filed May 18, 1893. Serial No. 474,631. (No model.)

To all whom it may concern:

Be it known that I, ROBERT F. RICE, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Telephone-Transmitters, of which the following is a specification.

This invention relates to telephone transmitters of the microphone order; the object being to furnish an improved instrument of this class especially adapted for and capable of transmitting with fullness and accuracy the speech of voices of different powers and tones, and to overcome in a large degree the difficulties met with in using the ordinary transmitters under the widely varying conditions of commercial telephony.

In the drawings accompanying and forming a part of this specification, Figure 1 is a sectional side elevation of a telephone-transmitter made in accordance with my present invention. Fig. 2 is a plan view of the instrument, in which some parts are broken away. Fig. 3 is a sectional view in line *a a*, Fig. 2. Fig. 4 is a sectional side view, similar to Fig. 1, of a modified form of the instrument which is shown in Figs. 1, 2, and 3. Fig. 5 is a broken plan view of this modification. Fig. 6 is a side view similar to Fig. 1, showing a modified form of the instrument in which the current-undulator has the members thereof disposed at an inclination to the direction of the force of the loads thereon. Fig. 7 is a view similar to Fig. 1, showing a modification of the transmitter in which the undulator elements are loaded by means of pressure devices applied thereto, these being substituted for the gravity-loads of the undulator elements shown in Figs. 1 to 6, inclusive. Fig. 8 is a broken front view illustrative of this modification of the instrument. Fig. 9 is a plan view, and Fig. 10 an edge view, of the form of undulator element shown in Figs. 1 to 3, inclusive. Fig. 11 is a plan view, and Fig. 12 an edge view, of the single-part undulator element shown in Figs. 4 and 5. Fig. 13 is a plan view, and Fig. 14 an edge view, of the multipart undulator element shown in Figs. 4 and 5. Fig. 15 is a plan view of the undulator element shown in Figs. 7 and 8.

Fig. 16 is a section in line *e e*, Fig. 15, of the undulator element shown in Figs. 7 and 8.

Similar characters designate like parts in all the figures.

The telephone transmitter shown in the drawings consists essentially of two principal parts, the voice-diaphragm and the current-undulator. The voice-diaphragm is a relatively thin plate of suitable substance, as for instance, sheet-metal, but preferably wood, supported in position for receiving the tones of the voice and adapted to carry the undulator for effecting the required successive modifications, or the so-called "undulations," of the electric current in the circuit in which the undulator is placed.

The current-undulator consists of a multiplicity of normally-contiguous surface-contracting members in circuit and placed one upon another under successively increased loads, and carried in the form of a pile of plates or elements, by the voice-diaphragm, in a manner substantially as hereinafter described, so as to participate in the vibrations of said diaphragm when this is subjected to the tones of the voice.

In all of the instances and modifications herein described, the contact-faces or surfaces of the undulator-elements are in directions crosswise to the direction of the force of the load to which these elements are subjected; and this is equally true as to each form of my improved telephonic apparatus; but it will, of course, be understood, (especially from Fig. 6 and from the description of the form of apparatus shown therein,) that the direction of said surfaces need not be at right angles to said lines of force, although, in my opinion, such an arrangement of the several parts, (substantially as shown in Figs. 1 to 5 inclusive,) is the preferable one.

By the term "undulator" or "current-undulator," as used herein to identify the transmitter element or part whereby are effected those modifications of the electric current required in the art of telephony for the transmission of speech, I do not intend to distinguish between a truly undulatory current and the so-called make-and-break current, or to identify the described transmitter element

as belonging to either the undulatory or the make-and-break systems of telephonic apparatus; but said terms are only used in a general sense, for designating in a general way a circuit-modifying element substantially such as hereinafter more particularly described. In this instrument it is, I think, probable that the general efficiency is the result of a peculiar combination not found in other transmitters. For instance, by making the undulator of a relatively low degree of sensitiveness, this is made less subject than ordinarily to inductive influences; and, on the other hand, by making the diaphragm of a relatively high degree of sensitiveness, this appears to be made operable by the finer tones of the voice to so actuate the undulator as to make this effective. By means of such peculiar relations, perhaps, the instrument, though it may electrically be of low sensitiveness, is still made effective for transmitting sensitive tones by reason of the sensitiveness of the diaphragm, and is made effective for transmitting the lower tones by the construction, or rather organization, of the undulator itself.

In Figs. 1, 2, 3, 9 and 10 is shown one preferred form or arrangement of my improved telephonic transmitter. In this modification, the voice-diaphragm 4, (Figs. 1, 2 and 3,) is shown horizontally disposed underneath the top-plate 5, of the transmitter-box. Said box may have the usual back-board 6, front-plate or wall 7, and side-walls 8 and 9. The top-plate 5 is shown in Fig. 1, furnished with a suitable mouth-piece 10, for directing the tones of the voice against the diaphragm 4. For holding the voice-diaphragm free of the top-plate of its box, suitable strips 12, of felt or other cushion-substance (as cork or the like) are shown placed along the edges of the diaphragm between this and said top-plate 5, the diaphragm being held in place under the top-plate by means of the screws 13, or other suitable and well-known fastening-devices.

The current-undulator, which is designated in a general way by D, is carried by the voice-diaphragm by means of the lower plate or element 24, of said undulator; which element is shown suspended underneath said diaphragm by means of suitable fixed connections therewith. In the present instance, those connections consist of the walls 15, 16, 17 and 18, which in practice are or may be strips of wood glued to the under side of the diaphragm and to the upper side of the lower element 24, as will be understood by comparison of the several figures of drawings. The other members, as 20, 21, 22 and 23, of the undulator, are supported in a pile upon the lower plate 24, being one superimposed upon the other, as illustrated in Figs. 1 and 3. For bringing the undulator-elements properly in circuit, one electric terminal 14, is brought in contact with the lower undulator element 24, (see Fig. 1,) and the opposite electric terminal 25 is con-

nected at 26, to the uppermost undulator-element 20, of the pile of elements. Said first-named terminal 14, is shown fixed at 27, by means of some suitable fastening, to one edge of the diaphragm, and connected through the coiled wire 28, (Fig. 1,) with the line-fastening 29. The opposite terminal is shown connected at 30, with the back-board of the transmitter-box where it joins the other end 31, of the electric line.

In Figs. 1, 2 and 3, the several plates or undulator-elements, 20, 21, 22 and 23, are freely disposed in horizontal planes in substantial parallelism with the plane of the diaphragm, and are subjected to successively-increased gravity-loads, (counting from the uppermost element 20 downwardly in the pile of elements,) by superimposing the plates one directly upon another, so that each plate, counting downwardly as stated, is subjected to the weight of an increased number of the plates or elements.

In making the undulator, I take a number of hard carbon-plates and work down the opposite sides thereof to a true surface, so that when superimposed as described, the several elements will have a full bearing and a "surface-contact" the one upon the other. The several parts are so proportioned and arranged, relatively to the size of the instrument and the particular character of the diaphragm, that the separation of the undulator-elements will take place more or less deeply in the pile accordingly as the diaphragm is subjected to a greater or lesser vibration. In this way, according to my experiments and as indicated by the instruments I have in use, the combination described is adapted for transmitting voice-impulses of varying intensities and powers; the separation of the plates by the combined action of the momentum thereof and of the vibration of the diaphragm practically corresponding in some way with the force and intensity of the voice-impulses. For transmitting some tones it may happen that only one, or at most two, of the upper plates to the pile will be lifted from their full bearing on the plates immediately below. On the other hand, if the pile of undulator-members be subjected to the vibration of the stronger tones of the voice, the action thereof upon the undulator will be different, and may separate even the lowermost members, or may separate all of the members, some to one degree and others to a greater or lesser degree; also the duration of the separations will be different at the successive contacting-surfaces of the pile.

A modified and improved form of the transmitter described in connection with Figs. 1 to 3, inclusive, is shown in Figs. 4 and 5, and is of essentially the same character, with the exception that here the successive superimposed undulator-members comprise single-part and multi-part elements in alternating succession; also, these elements are shown of an oblong

form, the multi-part elements, shown in detail in Figs. 13 and 14, being divided at 32, in two parts, separately designated by 21^{a'} and 21^{a''} respectively. As in the form of the instrument previously described, the freely-disposed undulator-elements 20^a, 21^a, 22^a and 23^a, are shown inclosed in a small case fixed to the under side of the voice-diaphragm 4, and comprising the sides 15, 16, 17 and 18, of the lower member 24^a of the undulator itself. This lower member 24^a constitutes a floor on which the other members of the undulator are supported in the form of a pile. In this form of the transmitter, the operation of the invention is modified and improved, the manner of the separation of the several plates or undulator-members being modified by the use of the alternating multi-part members; so that, in practice, I apprehend the single-part plates may not be lifted (by the vibration of the entire structure) or separated equally at each end, but, instead, to different degrees; thereby securing, in my opinion, a more perfect undulatory action of the entire combination, and avoiding to some extent any tendency of the apparatus to operate upon the so-called "make-and-break" principle. The single-part elements 20^a and 22^a of this form of the instrument are shown in plan and edge view, respectively, in Figs. 11 and 12.

The undulator designated in a general way by D' in Figs. 4 and 5, consists of a multiplicity of surface-contacting members under successively increased gravity-loads. The single-part members (including the floor 24^a, of the pile and counting from the uppermost member downward,) consists of the plates or element-members 20^a, 22^a and 24^a. Alternating with these are the multi-part members 21^a, and 23^a; each of these multi-part members consisting in the present instance of two member-parts designated by 21^{a'} and 21^{a''}, and by 23^{a'} and 23^{a''}, respectively. The uppermost multi-part member 21^{a'}, is under the load of the single-part member 20^a; the second single-part member 22^a, is under the increased load of the two members 20^a and 21^a, which are supported thereon; and, in like manner, the second multi-part member 23^a is under the further increased load of the three element-members supported thereon; and finally, the lower element-member 24^a, (which in this instance is the floor of the pile) is under the still greater load of the four superimposed element-members supported thereon.

As I have hereinbefore mentioned, the several undulator-elements or plates described are located in directions crosswise to the line of force (indicated by the arrow 41), of the loads of the undulator-elements; but said elements may in some cases be disposed at some inclination to said line of force, as indicated, for instance, in Fig. 6, which corresponds, except for said inclination of the undulator-elements, to the sectional view, Fig. 4. With the exception of the single additional feature here illustrated, the foregoing description of

the features illustrated in Figs. 4 and 5, applies equally to the modification illustrated by Fig. 6.

While the successively increased loads of the successive undulator-members are preferably obtained directly by gravity, as may be done by supporting these members one upon the other in a pile, preferably as illustrated in Figs. 1 to 5, inclusive, nevertheless, if for any reason it is required to support the voice-diaphragm in a position vertical or nearly so, said successively increased loads may be obtained by means of pressure-devices of proper strength applied to the successive undulator-members respectively. This mode of, and an apparatus suitable for thus loading in the required manner the successive undulator-elements is illustrated in Figs. 7 and 8. According to this modification, the voice-diaphragm 4 is placed in a vertical position, as illustrated in said figures of drawings, and is shown furnished with the shelf 42, on which are set edgewise the several elements, 20^b, 21^b, 22^b, 23^b and 24^b, of the current-undulator D³. Said undulator-elements 20^b, 21^b, 22^b, 23^b and 24^b, are shown provided at the opposite ends thereof with holes or pivot-bearings at 50, in which bearings engage the points of the successive springs 51, 52, 53, 54 and 55, that are shown supported by a bar or arm 56, that is fixed to the frame or case of the telephone transmitter. Said successive springs, counting from the spring 51, forwardly toward the diaphragm, may be of successively increased or decreased strength, so as to modify the effects or loads upon the successive undulator-elements 20^b, 21^b, 22^b, 23^b and 24^b, respectively. By this means the loading of the undulator-pile and the several elements thereof is effectuated in a manner which may closely correspond, in practice, to that obtained by gravity in the preferred form of my improvement described in connection with Figs. 1, 2 and 3.

When the several pressure-devices or springs are of the same strength, of course each succeeding undulator-element, counting from the rearward element 20^b, toward the diaphragm in Fig. 7, is under the load of an increased number of said springs. In this case, the loading of the successive undulator-elements is said to be regular, or regularly increased.

For making the required circuit, and for properly putting the undulator in circuit, the spring 55, connecting with the forward-plate 24^b, of the undulator, is shown engaging with a metallic bar, 57, to which bar one end 58 of the electric line is connected. The rearward undulator-plate 20^b, is similarly shown connected, through its spring 51 and the metallic bar 59, with the opposite end 60 of the electric line. By this means, the aforesaid arm 56 being a non-conductor, the required circuit through the undulator-members is completed.

In the gravity-load form of the undulator,

- the intermediate members thereof are freely supported—that is, supported free of any control or resistance to vertical movement except such as results from the loading of those members; and are also supported substantially free of any side-pressure or resistance. By reason of this organization of the parts, said intermediate undulator-elements are said to be freely disposed one upon another.
- 10 Having thus described my invention, I claim—
1. In a telephone transmitter, the combination with a vibratory diaphragm, of a current-undulator comprising a plurality of normally-contiguous and relatively-movable undulatory elements, one of which is secured to the diaphragm for vertical movement therewith, and the others of which are interposed between the diaphragm and said first-mentioned element and have a limited range of vertical movement between the same.
 2. In a telephone-transmitter, the combination with a vibratory-diaphragm, of a current-undulator comprising a plurality of normally-contiguous and relatively-movable undulatory elements, one of which is fixedly secured to the diaphragm for vertical movement therewith, and the others of which are interposed between the diaphragm and said first-mentioned element and have a limited range of movement between the same.
 3. In a telephone transmitter, the combination with the diaphragm of an undulator consisting of a multiplicity of surface-contacting members under successively increased loads, and comprising single-part and multi-part members in alternating succession.
 4. In a telephone transmitter, the combination with the voice diaphragm, of a multiplicity of surface-contacting undulator-elements in circuit and carried by said diaphragm under successively-increased gravity-loads, and comprising single-part and multi-part elements in alternate succession.
 5. In a telephone-transmitter, the combination with a vibratory diaphragm, of a current-undulator comprising a plurality of relatively movable undulatory elements supported one by the other under successively-increased loads respectively, one of said elements being secured to the diaphragm for vertical movement therewith, and the others of said elements being interposed between the diaphragm and said first-mentioned element having a limited range of vertical movement between the same.
 6. In a telephone transmitter, the combination with the diaphragm, of an undulator consisting of a multiplicity of superimposed plates and comprising single-part and multi-part plates in alternate succession.
 7. In a telephone transmitter, the combination with the voice-diaphragm, of a multiplicity of surface-contacting undulator-elements in circuit and carried by said diaphragm under successively increased loads, and comprising single-part and multi-part elements in alternating succession.
 8. In a telephone-transmitter, the combination with a vibratory diaphragm, of a current-undulator comprising a plurality of superimposed relatively-movable flat plates, carrying successively-increasing resistant loads respectively, one of said plates being secured to the vibratory part of the diaphragm for vertical movement therewith, and the other plates being interposed between the diaphragm and said first-mentioned plate and having a limited range of movement between the same.
 9. In a telephone-transmitter, the combination with a horizontally-disposed vibratory diaphragm, of an undulatory element secured to and suspended below the middle portion of said diaphragm for vertical movement therewith, and a plurality of superimposed members supported upon said suspended member, and carrying successively-increasing resistant-loads respectively, and interposed between and having a limited range of vertical movement relatively to the diaphragm and said suspended member.
 10. In a telephone-transmitter, the combination with a horizontally-disposed vibratory diaphragm, of an undulatory element comprising three or more superimposed members supported one upon the other for undulatory or lifting movement toward and from the diaphragm and supported on the diaphragm by a rigid attachment of the lower member with the middle portion of said diaphragm.
 11. In a telephone-transmitter, the combination with a horizontally-disposed vibratory diaphragm supported at its outer edges, of a casing fixedly secured to the middle portion of said diaphragm and vertically movable therewith, and a plurality of successive flat plates disposed within said casing and supporting successively-increasing resistant-loads respectively, and adapted to have a limited range of vertical movement between said diaphragm and the opposite wall of the casing.
 12. In a telephone-transmitter, the combination with a current-undulator comprising a plurality of superimposed relatively-movable contacting elements having flat surfaces, and carrying successively-increasing gravity-loads respectively, and disposed with their contacting surfaces in planes transverse to the line of force of said loads, and movable along said line of force, of a vibratory diaphragm mounted in a plane substantially parallel with the planes of the undulatory elements, and secured to one of said elements, and adapted to limit the range of movement of the intermediate elements in one direction, substantially as described.
 13. In a telephone-transmitter, a horizontally-disposed vibratory diaphragm fixed at its outer edges, a flat carbon-plate fixed to the middle portion of said diaphragm in parallelism therewith, a series of flat carbon-plates

supported one upon the other and all upon said fixed plate between said fixed plate and diaphragm and so disposed relatively to each other as to have an undulatory movement toward and from each other and toward and from the diaphragm and in lines parallel therewith, and an electrical circuit having one terminal thereof connected to said fixed plate, and the other terminal thereof connected to the plate immediately adjacent to the diaphragm, substantially as described.

14. In a telephone-transmitter, the combination with a horizontally-disposed vibratory diaphragm, and with the terminals of an electric circuit, of an undulatory element secured to and suspended from the middle portion of said diaphragm for vertical movement therewith, means for connecting said element with one terminal of said circuit, a plurality of superimposed undulatory members supported upon said suspended member, and interposed between the same and the diaphragm, and having a limited range of movement between the diaphragm and the suspended member, and carrying successively-increasing resistant-loads respectively, and means for connecting one of said undulatory elements with the

opposite terminal of the circuit, substantially as described.

15. In a telephone-transmitter, the combination of a horizontally-disposed vibratory diaphragm, an electrical circuit having two terminals, an undulatory element comprising three or more superimposed members supported one upon the other for undulatory lifting movements toward and from, and in a plane coinciding with the plane of, the diaphragm and supported on the diaphragm by a rigid-attachment of the lower member with the middle portion of said diaphragm and connected the lower one of said members to one terminal and the other of said members to the other terminal of the electrical circuit, substantially as described.

16. In a telephone transmitter of the class specified, the combination with the vibratory diaphragm adapted for carrying a pile of carbons, of a series of three or more superimposed carbon elements consisting of single-plates and multiple-plates alternately.

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