(No Model.)

4 Sheets—Sheet 1.

C. A. RANDALL.

TELEPHONE TRANSMITTER.

No. 312,161. Patented Feb. 10, 1885.

Fig. 1.

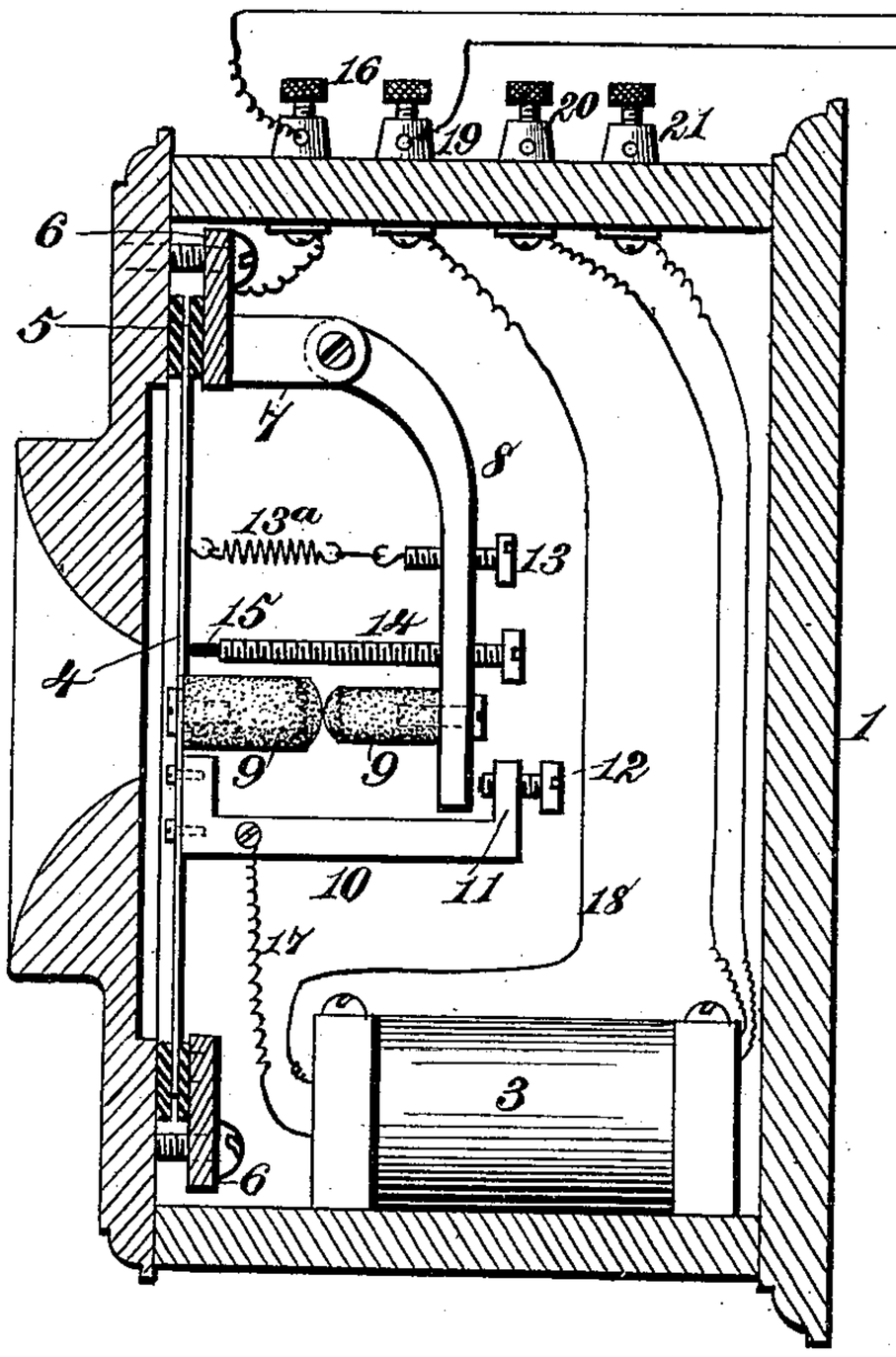


Fig. 2.

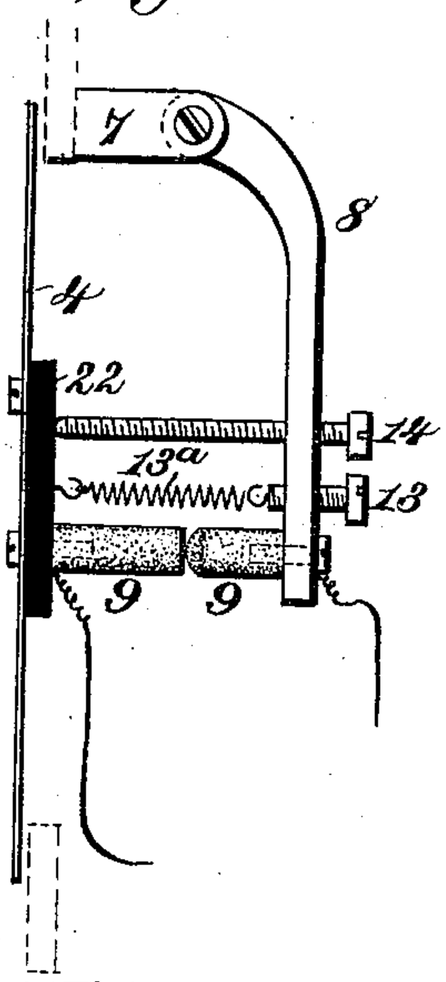


Fig. 3.

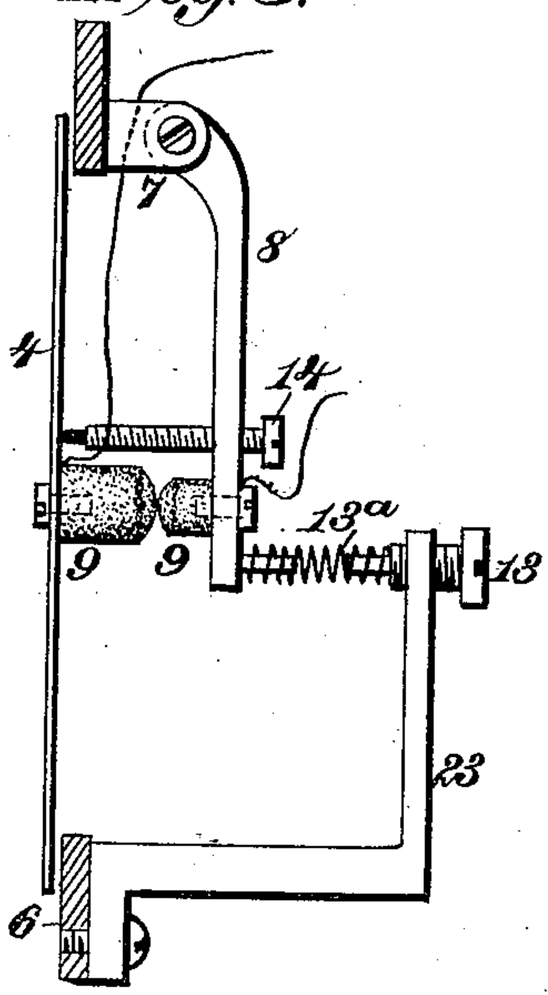
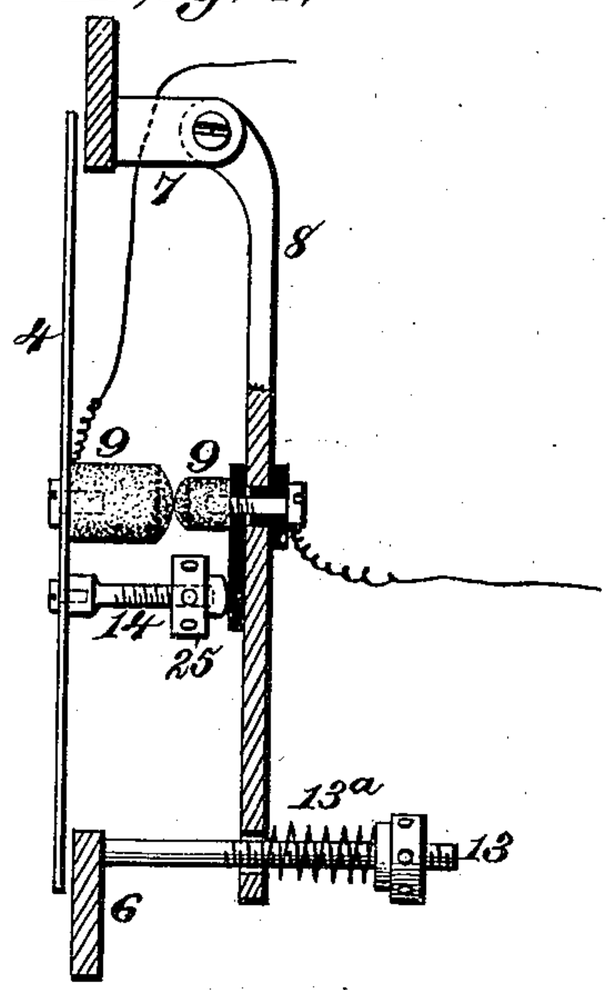


Fig. 4.



Witnesses.
Robt Everett.
J. A. Rutherford

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By James L. Norris.
Atty.

(No Model.) 4 Sheets—Sheet 2.

C. A. RANDALL.

TELEPHONE TRANSMITTER.

No. 312,161. Patented Feb. 10, 1885.

Fig. 1.

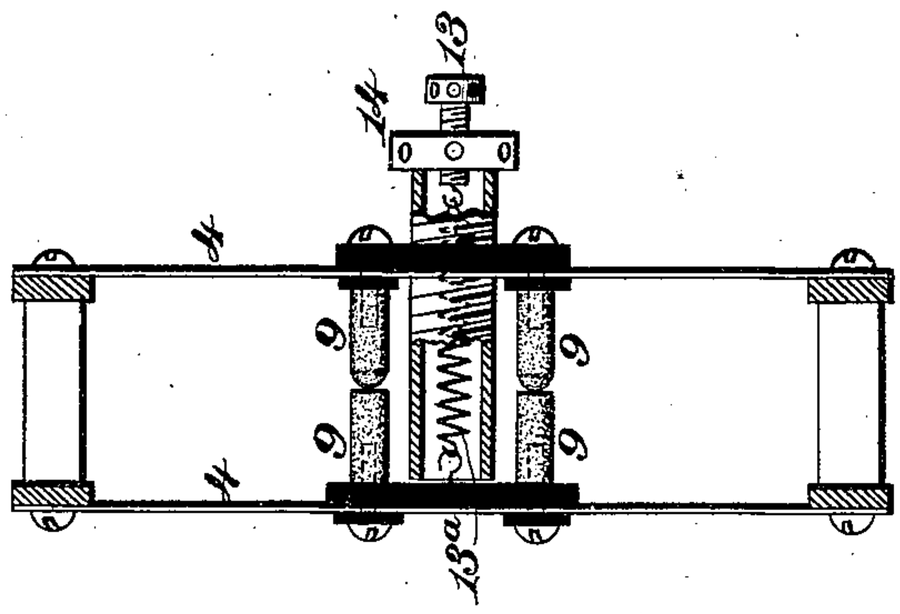


Fig. 6.

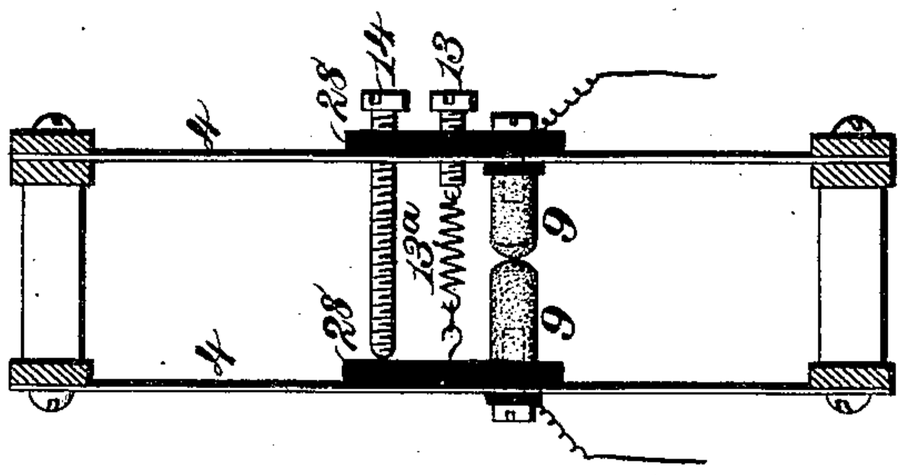
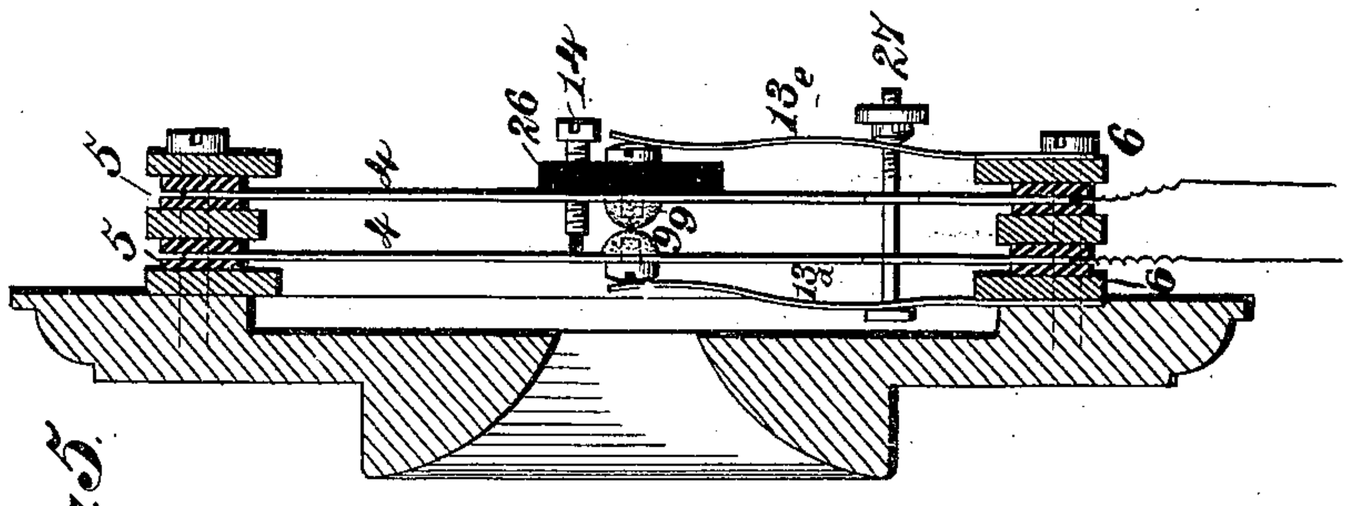


Fig. 5.



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(No Model.)

4 Sheets—Sheet 3.

C. A. RANDALL.

TELEPHONE TRANSMITTER.

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Fig. 8.

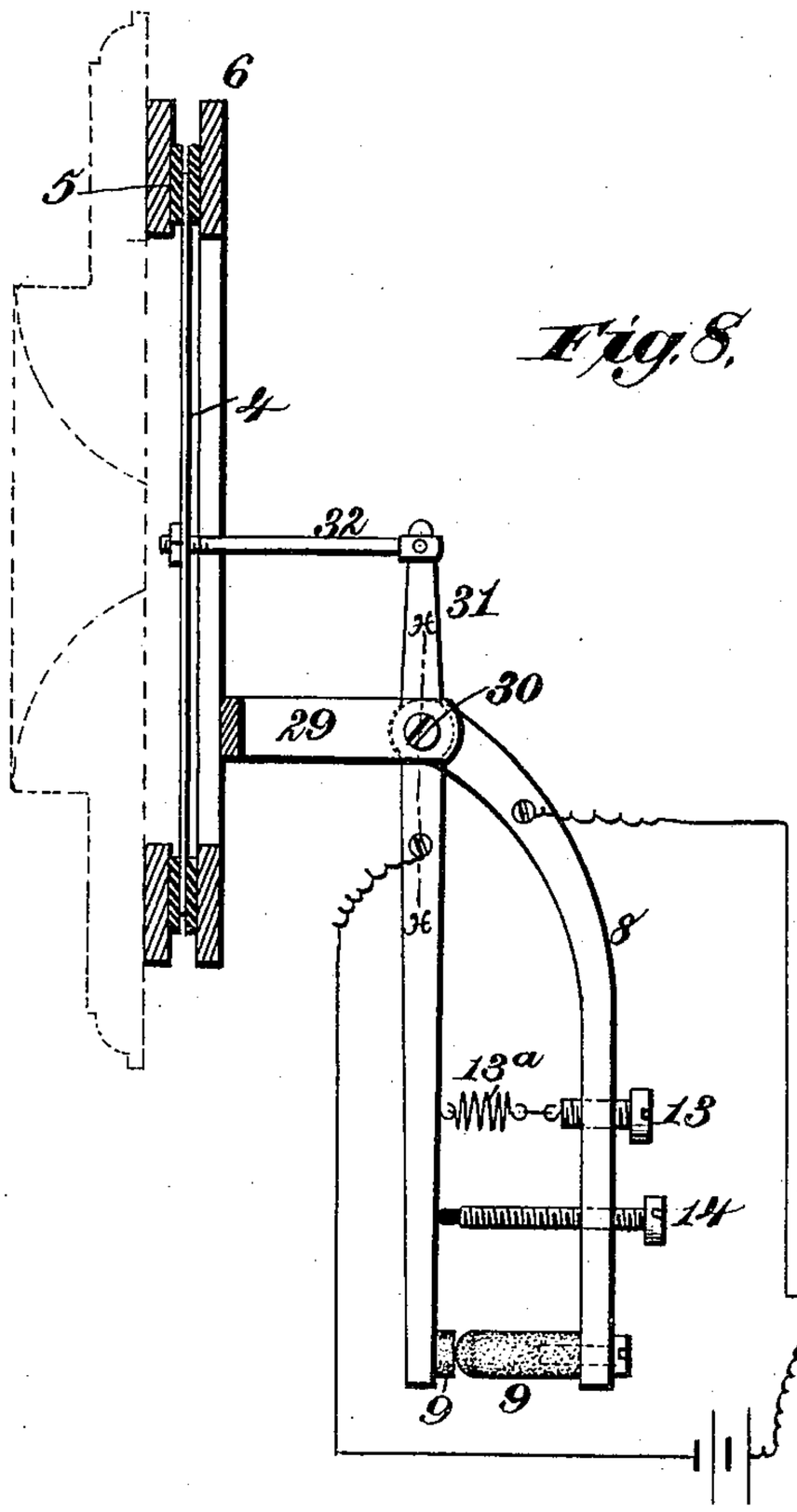


Fig. 8a.

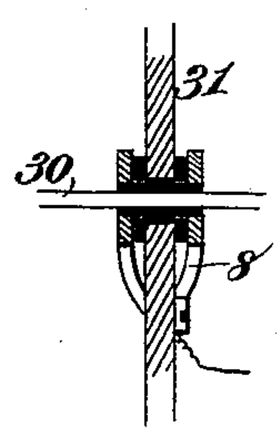


Fig. 9.

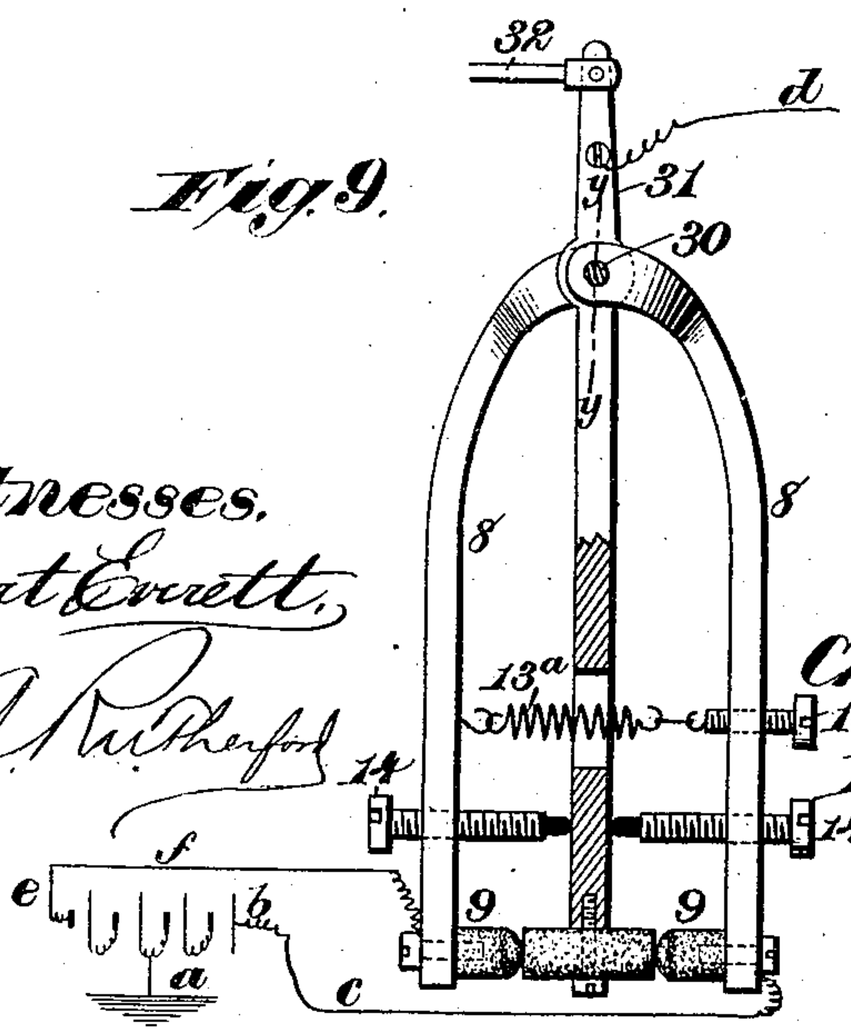
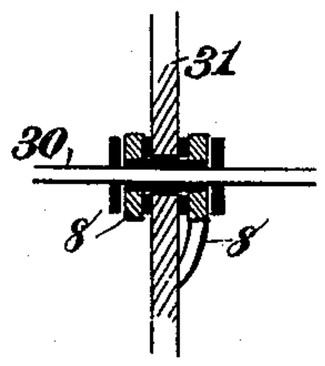


Fig. 9a.



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(No Model.)

4 Sheets—Sheet 4.

C. A. RANDALL.

TELEPHONE TRANSMITTER.

No. 312,161. Patented Feb. 10, 1885.

Fig. 10.

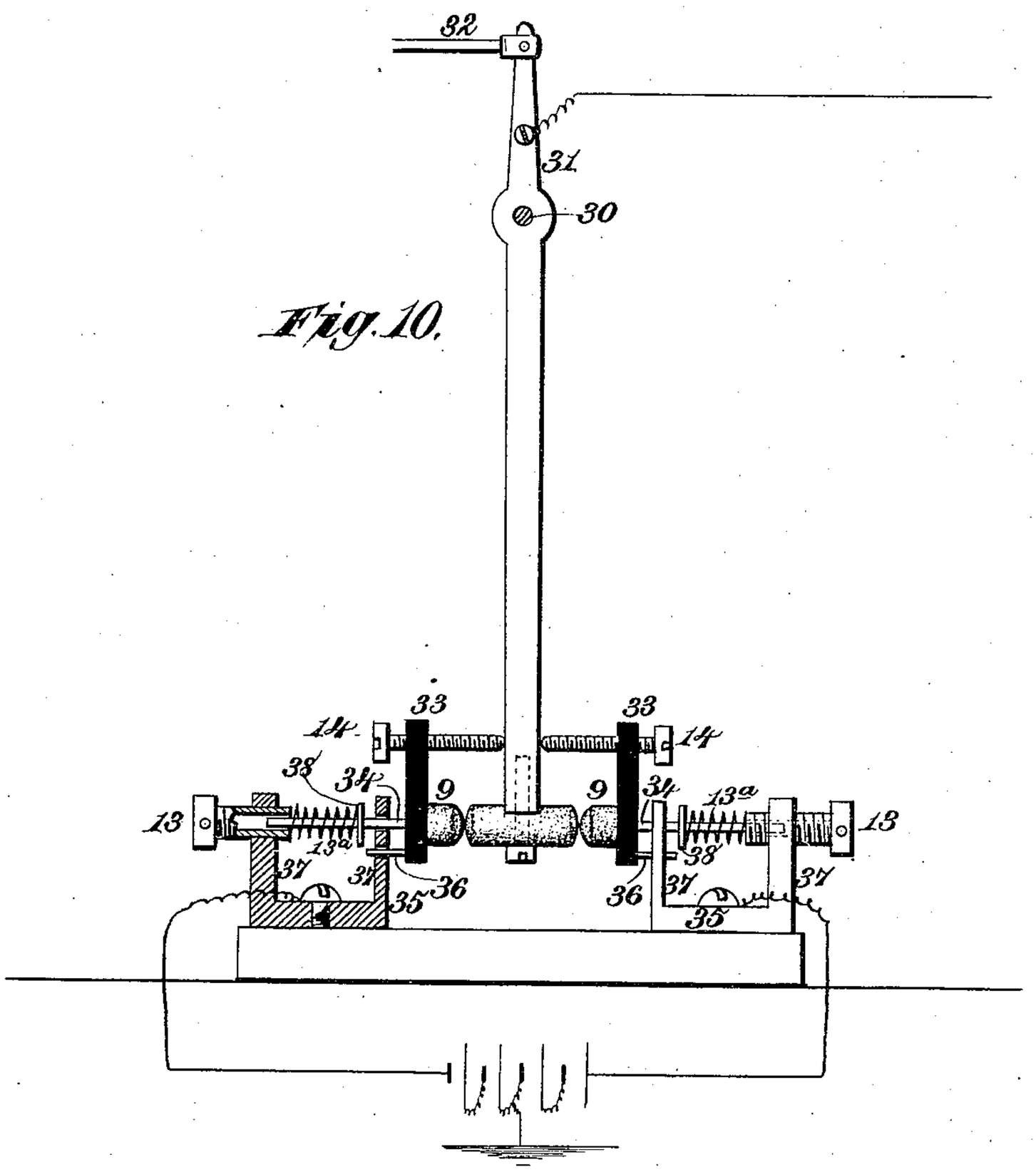
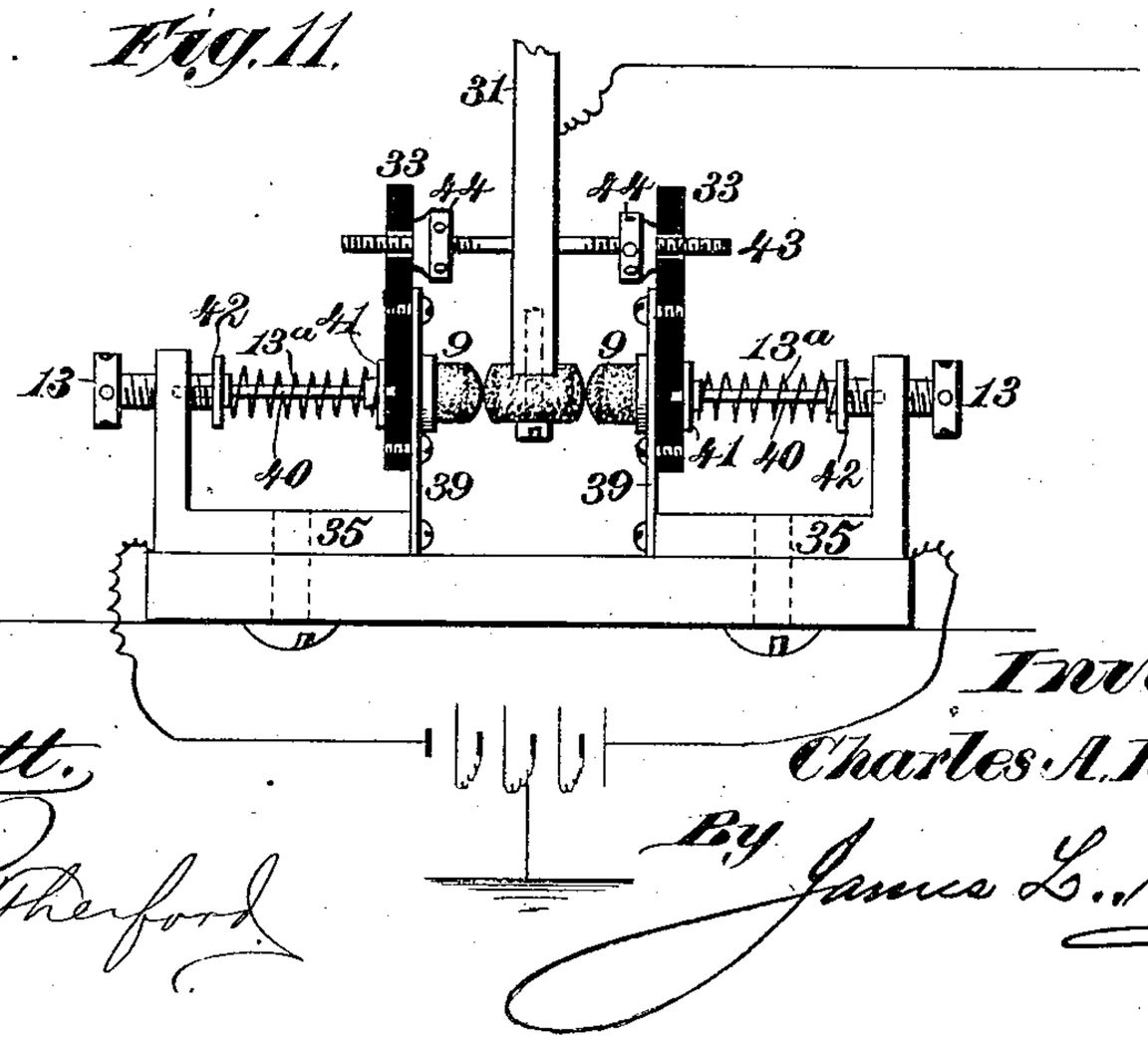


Fig. 11.



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J. A. Rutherford

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Charles A. Randall,
By James L. Norris.
Atty.

UNITED STATES PATENT OFFICE.

CHARLES A. RANDALL, OF NEW YORK, N. Y.

TELEPHONE-TRANSMITTER.

SPECIFICATION forming part of Letters Patent No. 312,161, dated February 10, 1885.

Application filed February 21, 1884. (No model.)

To all whom it may concern:

Be it known that I, CHARLES A. RANDALL, a citizen of the United States, residing at New York, in the county and State of New York, have invented new and useful Improvements in Telephone-Transmitters, of which the following is a specification.

This invention relates to improvements in apparatus for transmitting sounds by means of electric currents from a battery, a diaphragm or vibrating medium, electrodes, and connections.

In battery transmitters as hitherto and now constructed it is usual to place the electrodes under control of the diaphragm or vibrator, and so arrange and support them that a light and delicate contact is produced between the same. In some instruments one of the electrodes is supported upon a sensitive diaphragm, or a sensitive spring bearing upon the diaphragm, while the other electrode is also carried by a sensitive spring, the electrodes being thereby held in very delicate contact in their normal position, or position of rest. In other instruments the devices are such as to depend upon gravity for the initial force of contact by delicately and independently supporting the electrodes, or arranging the electrodes so that one carries or supports the other. In most instruments of the character alluded to the object sought or attained appears to be that the vibrations of the diaphragm or vibrator shall be perfectly free and not interfered with, and that the normal contact of the electrodes shall be light and delicate, as in a microphone, so as to be readily disturbed by the slightest vibration of the diaphragm or vibrator, to create a variation of the pressure-contact between the electrodes, the maximum of which must be exceedingly light and delicate from the nature of the apparatus. The delicate suspension or support and contact of the electrodes are a necessity, in that ordinary transmitters become inoperative if the electrodes are pressed together by a spring which is too stiff, or if the electrodes have too firm contact by gravity of one or more of the parts. The chief disadvantage of such instruments is that by reason of the light and delicate support and contact of the electrodes it is impossible to utilize other than a light battery-current, for the reason that only a light current can pass through electrodes which are in delicate contact and so supported, in consequence of which the distance to which sounds may be transmitted, as well as the power with which the receiving-instrument may be operated, is limited to results depending upon the employment of a light battery-current.

The objects of my invention are to avoid the objections stated in electric sound-transmitters; to provide means whereby the electrodes are supported in a comparatively stiff or rigid manner as compared to any transmitter of which I am aware; to provide means whereby the electrodes may be brought into a firm and strong contact; to provide means whereby the electrodes can be brought into firm and strong contact and be adjusted and maintained in proper relative position when at rest, or in their normal position, thus supporting the electrodes in a comparatively stiff or rigid manner in such position, the rigidity of support and contact being only limited by the capacity to vibrate one or more of the electrodes by sound-vibrations directly or indirectly; to provide means whereby the electrodes may be brought into firm and strong contact, and the vibrations or movements of the electrodes toward each other confined to certain limits; to provide means whereby a current of great electro-motive force or power can be rapidly passed through a battery transmitter, and varied and utilized in transmitting sounds on circuits of greater length or distance than in ordinary transmitters of which I am aware, while the power with which the receiving-instrument may be operated is thereby increased.

The objects of my invention I accomplish in the manner and by the means hereinafter described and claimed, reference being had to the accompanying drawings, in which—

Figure 1 is a vertical central sectional view of an electric sound-transmitting instrument embodying my invention. Figs. 2 to 11, inclusive, are detail elevations showing modifications of the invention.

Referring to Fig. 1, the number 1 indicates the box or frame of a transmitter, which may

be of any suitable construction; 2, the battery; 3, the induction-coils, and 4 a diaphragm or other suitable vibrator secured in the box or frame over the usual opening therein. The diaphragm or vibrator is suitably insulated from the box by insulating-strips 5, and to the box is secured a metallic ring or plate, 6, insulated from the diaphragm, and having a stud, 7, to which is pivoted one end of a pendent arm, 8, carrying at its lower end portion one of the electrodes 9. The other electrode 9 is secured centrally to the diaphragm, and to the latter, under its electrode, is attached an inward-projecting bracket, 10, having a stud, 11, at its inner end, provided with a set-screw, 12, having an insulating point or piece adapted to bear against the free end of the pivoted electrode-carrying arm 8. This arm is provided with an adjusting-screw, 13, to which one end of a coiled or other spring, 13ª, is attached by a string or other insulating medium, the opposite end of the spring being connected with the diaphragm, whereby the two electrodes will normally be drawn toward each other and into firm and strong contact. The arm 8 is also provided with an adjusting-screw, 14, bearing by a point or piece, 15, of insulating material, against the diaphragm in such manner that when the electrodes have been brought toward each other and into firm and strong contact they can be adjusted to the proper relative position by turning the screw 14 to the right, which thereby moves the diaphragm and pivoted arm slightly away from each other, and hence the electrodes are normally, or in their position of rest, maintained in proper relative position for use, inasmuch as the adjusting-screw tends to hold the electrodes in their movement in one direction, while the tendency of the spring is to hold the electrodes in firm contact. It will be noted that in the normal position of the parts, or as they are arranged for operation, the end of the screw 12 does not bear against the arm 8, carrying one of the electrodes. It is, however, as stated, adapted to bear thereagainst and limit its outward movement. Furthermore, by the use of the spring 13ª and the screw 14 the electrodes are adjusted to a normally firm strong contact, which can be varied in the degree or force of contact by the movement of the diaphragm and its hammer-like blows, as hereinafter explained.

The electrodes are thus practically supported in a rigid manner as compared to ordinary instruments of this class, the limit of rigidity being dependent only on the ability or capacity to vibrate one or both of the electrodes by vibrations of the diaphragm or other vibrator. It will also be observed that in this arrangement the adjusting-screw can follow the vibration or change of position of the vibrator, in order that the normal position of the electrodes may remain unchanged. The connections are from the battery to the post 16, to ring or plate 6, to arm 8, to the electrodes and diaphragm, to wire 17, to the primary of the induction-coil, thence back by wire 18 to post 19, to battery, the secondary of the induction-coils connecting with posts 20 and 21 for the line-wires.

In Fig. 2 the diaphragm is provided with a block, 22, of hard rubber, to which the electrode 9 is attached, the spring 13ª and adjusting-screw 13 being located on the pivoted arm 8, between the adjusting-screw 14 and the electrodes. In this modification the insulating-point 15 of the adjusting-screw 14 is not necessary if the end of the screw bears against the hard-rubber block on the diaphragm.

In Fig. 3 the adjusting-screw 13 is carried by a bracket, 23, secured to the metallic ring or plate 6, and the spring 13ª acts to press the pivoted arm 8 toward the diaphragm 4 to bring the electrodes 9 into firm and strong contact, the adjusting-screw 14, for adjusting the position of the electrodes, being carried by the pivoted arm 8.

In Fig. 4 the pivoted arm 8 is insulated from its electrode 9 by suitable material, and the spring 13ª is arranged on a screw-threaded rod having a screw-nut to adjust the tension of the spring, while the device 14, for adjusting the electrodes, is secured to the diaphragm or vibrator 4, and its adjustable nut 25 bears against a hard-rubber block secured to the pivoted arm 8. In this modification the spring 13ª presses the pivoted arm toward the diaphragm or vibrator 4, to bring the electrodes into firm and strong contact, while the electrodes are adjusted and normally held in proper relative position by adjusting the nut 25 so that it presses against the rubber block on the pivoted arm 8.

In Fig. 5 I provide two parallel diaphragms, 4, arranged with an intervening space, the outer diaphragm, 4, having a central electrode, 9, attached by a screw, on which bears the free end of a flat spring, 13ª, while the inner diaphragm is provided with an electrode, 9, and a block of hard rubber, 26, a screw passing through the latter to secure the electrode in place, and a flat spring, 13ᵉ, bearing at its free end on the head of such screw. The tension or pressure of the springs is controlled by a screw-threaded bolt, 27, and an adjustable nut thereon. The two diaphragms are supported by and insulated from two metallic rings or plates, 6, attached to the front of the box or frame, and the flat springs are secured to said rings or plates, respectively. The screw 14, for adjusting the electrodes, passes through the hard-rubber block 26 and bears by an insulating-point against the outer diaphragm.

In Fig. 6 two diaphragms, 4, are provided, and carry the electrodes 9, which are insulated from the diaphragms by pieces or blocks 28 of hard rubber, and the set-screw 13, for adjusting the tension of the coiled spring 13ª, as well as the electrode-adjusting screw 14, pass through the hard-rubber block on one of the diaphragms.

In Fig. 7 I use two sets of electrodes 9, sup-

ported by the two diaphragms 4 4, and insulated therefrom by pieces of hard rubber, as in Fig. 6. The electrode-adjusting screw 14 is tubular, and passes through the hard-rubber block of one diaphragm to bear against the hard-rubber block on the other diaphragm. The spiral spring 13ª is arranged in the tubular screw and connects with its tension-adjusting screw 13, which screws into the head of the tubular screw.

In Fig. 8 a single diaphragm, 4, is used, and the metallic ring or frame 6 is provided with a stud, 29, having a pin or shaft, 30, on which are hung, by insulating bearings, a pendent lever, 31, and the arm 8, each carrying an electrode, 9, at its lower end, the lever connecting with the diaphragm by a rod, 32.

The set-screw 13, for adjusting the tension of the spiral spring 13ª, and the electrode-adjusting-screw 14 are carried by the arm 8, while the spring connects with the lever 31, and the screw 14 bears against the lever by an insulating-point. In this modification the lever and arm are drawn toward each other, and the electrodes brought into firm and strong contact by the stiff spring 13ª, while the relative normal position of the electrodes is determined and maintained by the adjusting-screw 14. The lever 31 becomes the vibrator in conjunction with the action of the diaphragm.

The detail, Fig. 8ª, is a section on the line *x x* of Fig. 8, showing the insulating-support of the lever and the arm on the pin or shaft.

In Fig. 9 the pin or shaft 30 carries the lever 31, and also two pendent arms, 8, each having an electrode, 9, at its lower end to come in contact, respectively, against opposite ends of an electrode on the lower end of the lever 31, said lever connecting with the diaphragm by a rod, 32, as in Fig. 8, and becoming the vibrator in conjunction with the action of the diaphragm. The two arms 8 are drawn together and the electrodes 9 brought into firm and strong contact with the electrode on the lever by the coiled spring 13ª, while the normal position of the electrodes is determined and maintained by independent adjusting-screws 14, passing, respectively, through the arms 8, and bearing by insulating-points against opposite sides of the lever 31.

The detail view, Fig. 9ª, is a section on the line *y y* of Fig. 9, showing the insulating-support of the lever and arms on the pin or shaft.

In this modification practically two batteries are used. As shown, the opposite poles of a battery having two or more cells are carried to the electrodes 9, while the center of said battery is connected to ground *a*, the circuit being from *b* by wire *c* to electrode 9, to lever 31, to line *d*, when the lever is in firmest contact with said electrode, and from *e* by wire *f* to electrode 9, to lever 31, to line *d*, when the lever is in firmest contact with the last-mentioned electrode.

In Fig. 10 the pivoted lever 31 is hung on a pin or shaft, 30, and carries an electrode at its lower end, while the electrodes 9 are secured, respectively, to blocks 33, of hard rubber, attached to slides 34, arranged in independent supports 35, and guided by pins 36, working in said supports. The supports each consist of a base-piece and two arms, 37, in the outer one of which is a tubular screw, 13, for adjusting the tension of the coiled springs 13ª, for which purpose one end of the spring abuts against the inner end of the tubular screw, while the other end bears against a collar, 38, on the slide 34. Each rubber block 33 carries the adjusting-screw 14, which bears against the lever 31, for independently adjusting the blocks and electrodes 9, the latter being brought into firm and strong contact with the electrode on the lever by the action of the springs 13ª.

In Fig. 11 the hard-rubber blocks 33 are secured to spring-plates 39, which carry the electrodes 9, and the coiled springs 13ª encircle pins 40, bearing at one end in the rubber blocks and at the other end passing into the tubular screws 13. One end of each spring bears against a collar, 41, on the inner end of the pin, while the other end of the spring bears against a collar, 42, of the set-screw 13, the latter being arranged in arms of the supports 35, to which supports the spring-plates 39 are attached. The lever 31, as in Fig. 10, carries an electrode at its lower end, and the electrodes 9 are pressed into firm and strong contact with the opposite ends of the electrode on the lever by the springs 13ª, the proper normal position of the electrodes being determined and maintained by a screw-rod, 43, rigid on the lever 31, and having its ends, respectively, passing through the hard-rubber blocks 33, and provided with screw-nuts 44. The outward adjustment of the nuts on the screw-rod determines the relative normal position of the electrodes.

In Figs. 10 and 11 the battery-connections are the same as described by reference to Fig. 9.

In all the different forms of my invention described and shown will be found the elements essential to bring the electrodes toward each other and produce a firm and strong contact thereof in contradistinction to a delicate and sensitive contact, as in a microphone; also that there is provision whereby the normal relative position may be determined and positively maintained while in a normal position, or condition of rest; and also that the electrode-adjusting device preferably follows the vibration or change of position of the vibrator, whereby the normal position of the electrodes may remain unchanged during inaction, or while in normal position.

The springs for bringing the electrodes toward each other and into firm and strong contact may have their tension adjusted by the set-screws provided for such purpose, thereby permitting the pressing-contact of the electrodes to be varied.

By bringing the electrodes into firm and strong contact and determining and maintaining the relative normal position of the electrodes it is practical to rapidly pass, vary, and utilize a current of greater electro-motive force than heretofore possible in any transmitter of which I have any knowledge. When the electrodes have been adjusted to the position they are to stand normally, or in their position of rest, they are comparatively stiff, or held in a rigid manner, and in practice the electrode-adjusting screw or device limits the movements of the electrodes toward each other, and the stop or contact-screw 12 limits the movement of the electrode upon the arm from the other electrode and prevents undue or accidental breaks of the circuit at the electrodes. The electrodes are independently insulated from each other, as will be clearly understood by reference to the drawings.

There may be two or any suitable number of electrodes, and the vibrator or diaphragm may be any device suitable for the purposes to be accomplished—namely, to vibrate one or more of the electrodes by sound-vibrations. While the electrodes are maintained in firm contact and in a comparatively rigid or stiff manner when in inactive or in normal condition, the succession of rapid hammer-like blows—concussions, in fact—taking upon them by the action of the diaphragm under the vibration of sound-waves, causes them to vary their contact during such action, notwithstanding their firm contact and comparatively rigid or stiff support. This is in accordance with known laws. Under mere pressure or slow movement the two, owing to their comparitively firm and rigid contact, will move together and the contact remain practically unvaried. Rapid quick blows—the hammer-like concussions of rapidly-following sound-waves—will set both in vibration, and the vibrations communicated to both will cause their contacts to be varied from maximum to minimum, and vice versa.

The terms "comparitively rigid or stiff" as used herein are not used to designate absolute rigidity or stiffness, but rigid or stiff relatively to the light delicate contacts and supports hitherto used in this art, the rigidity or stiffness being carried to just within the limit of vibration under the blows or concussions of sound-waves.

Having described my invention, what I claim is—

1. In a battery telephone-transmitter, the combination, with the electrode-supports and the electrodes, of a spring adapted and adjusted to bring the electrodes into firm and strong contact normally, and an adjusting-screw for maintaining them normally in such relative position and limiting the movement of the electrodes toward each other upon vibration of the diaphragm, substantially as described.

2. In a battery telephonic transmitter, the combination of a battery, a vibrator, electrodes controlled thereby, a spring arranged and adjusted to bring the electrodes into firm strong contact, and an adjustable screw, controlling and maintaining the normal relation of the electrodes, and limiting the movement of the electrodes toward each other upon vibration of the diaphragm, substantially as described.

3. The combination, in a battery telephonic transmitter, of a spring for bringing the electrodes toward each other normally in firm strong contact, the electrodes brought into such contact, and an adjustable stop for limiting and controlling the action of the spring, and maintaining such normal contact during inaction, and limiting the movement of the electrodes toward each other upon vibration of the diaphragm, substantially as described.

4. The combination, with the electrodes of an electric battery transmitter, of a spring for bringing the electrodes toward each other to produce a firm strong contact, and an adjusting-screw limiting and regulating the action of the spring, whereby the normal relative position of the electrodes is adjusted and maintained, substantially as described.

5. In a battery transmitter, the combination of the electrodes independently insulated from each other, a spring for impelling the electrodes toward each other and bringing them into firm strong contact, and an adjustable screw for limiting the action of the spring, whereby the relative position normally of the electrodes is maintained and their movement toward each other limited, substantially as described.

6. The combination, with the electrodes of a battery transmitter, of a spring acting to bring the electrodes into firm strong contact, and an adjusting-screw passing through one electrode-carrier and taking upon the other, whereby the electrodes are adjusted to and maintained in their normal relative positions, substantially as described.

7. The combination, with the electrodes of a battery, of a spring bringing the electrodes into firm strong contact, an adjusting device controlling and regulating the tension of the spring, and an adjusting-screw for determining and regulating the minimum distance apart of the electrode-carriers and maintaining the electrodes in their normal relative position, substantially as described.

8. In a battery telephonic transmitter, the combination, with the electrode-supports and the electrodes, of a spring for bringing the electrodes into contact, and an adjusting-screw for maintaining them normally in such relative position and limiting the movement of the electrodes toward each other upon vibration of the vibrator or diaphragm, and an adjustable stop for limiting the movement of the electrodes from each other upon vibration of the diaphragm or vibrator, substantially as described.

9. In a telephonic battery transmitter, the

combination, with the electrode-supports and the electrodes, of a spring for bringing the electrodes into contact, and an adjustable point for limiting the movement of the electrodes from each other upon vibration of the diaphragm inwardly, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES A. RANDALL.

Witnesses:
JAMES L. NORRIS,
J. A. RUTHERFORD.