(No Model.)

S. D. FIELD.

ELECTRIC TELEPHONE.

No. 552,173. Patented Dec. 31, 1895.

Fig. 1.

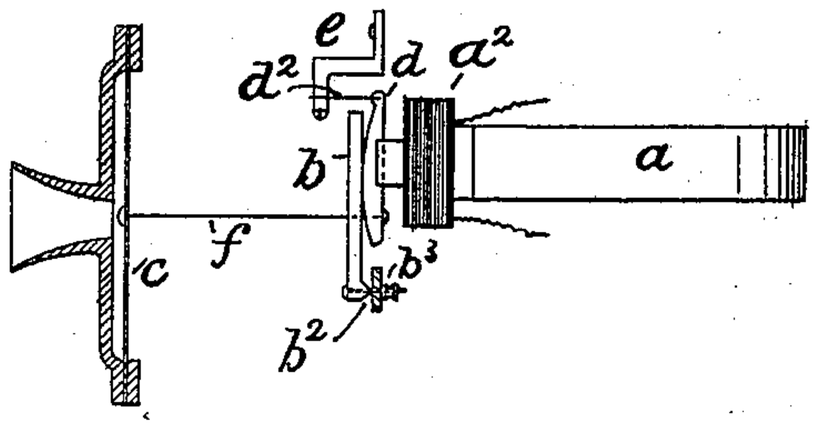


Fig. 2.

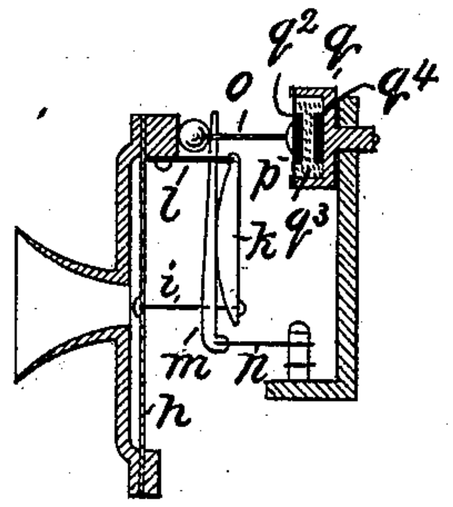


Fig. 3.

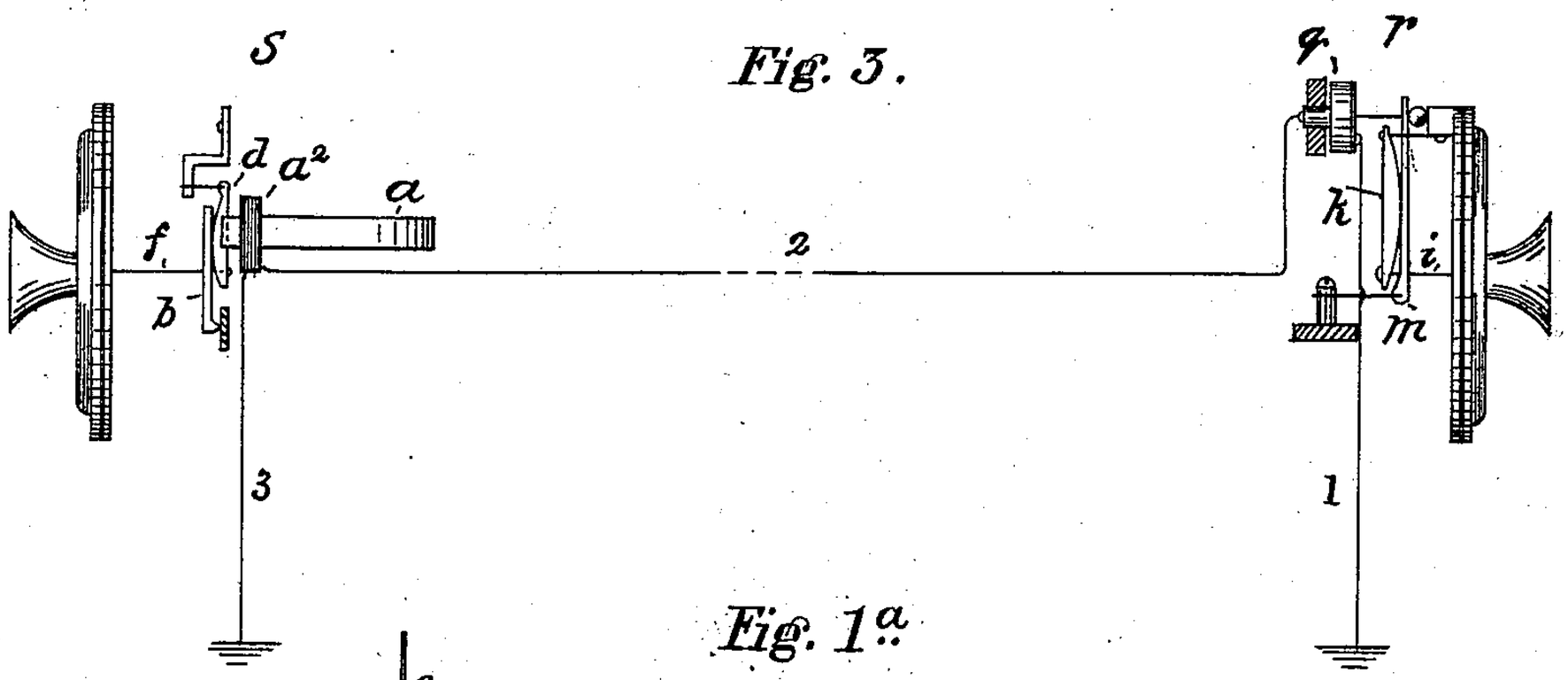
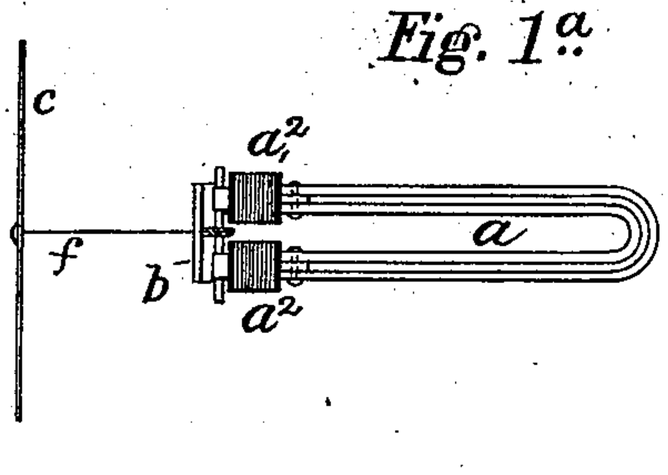


Fig. 1ª.



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UNITED STATES PATENT OFFICE.

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ELECTRIC TELEPHONE.

SPECIFICATION forming part of Letters Patent No. 552,173, dated December 31, 1895.

Application filed August 5, 1895. Serial No. 558,244. (No model.)

To all whom it may concern:

Be it known that I, STEPHEN D. FIELD, residing at Stockbridge, in the county of Berkshire and State of Massachusetts, have invented certain Improvements in Electric Telephones, of which the following is a specification.

My invention concerns the construction of electric speaking-telephones, being a device for improving the transmission of speech through conductors or cables characterized by high static retardation. Its purpose is to produce a transmitted current somewhat analogous to that employed in "curb" signaling, in the case of the telephonic current, shortening or degrading the heavier pulsations created by heavy tones, and accentuating or magnifying the finer vibrations and harmonics.

As is well known, the sounds constituting articulate speech comprise various fundamental vibrations, which are accompanied with numerous superposed harmonic vibrations. The undulatory current created in the electrical transmission of such sounds is of course of similar character, being the resultant of heavy current pulsations corresponding to fundamental tones and innumerable accompanying vibrations of higher period and less amplitude.

It is found in the practical transmission and reproduction of articulate sounds that the feeble and rapid fluctuations of current are affected by various electrical characteristics of the circuit in a different degree from the slower fundamental vibrations. They experience greater opposition from the impedance in the conductor and suffer more serious dissipation in the insulating medium of the circuit. Hence if the vibrations of the transmitted current were of amplitudes in strict proportion to those of the sound-waves impinging upon the transmitting-instrument, the reproduced sounds would be of quite different quality from the original sounds, the characteristic harmonics having been degraded or eliminated through various reactions of the circuit.

In the present invention I have endeavored to compensate for this unequal degradation of current pulsations of different periods and amplitudes by means of a mechanical device in the telephone which acts to accentuate or magnify the more rapid and feebler vibrations while diminishing the amplitude of the heavier vibrations. By thus transforming the mechanical vibrations of the transmilting-diaphragm into distorted or disproportionate vibrations in the electric current, it is possible to compensate for the unequal effects of the circuit upon the different vibrations and to produce in the receiving-instrument mechanical vibrations in strict conformity with those of the transmitting-instrument.

In long insulated conductors or cables the static effect upon varying currents is particularly prominent, being known in the art as "static retardation." This so-called "retardation is in fact an absorption of the energy of the current, and results in the extinction of the characteristic harmonic undulations.

The present invention therefore applies particularly to transmission through long cables or between distant stations.

This invention contemplates the interposition between the vibrating diaphragm and the transmitting device proper—the current-modifying portion of the transmitter—of a system of compensating-levers of the type known as "Houdin's compensating device," as modified and improved by me. One of the levers is pivoted or movably supported at one extremity and has its other extremity connected with the transmitting device. The other lever, which abuts upon the first-mentioned lever, and has a curved surface rocking upon that lever, is also movably supported at one extremity, and has its other end fixed to the transmitting-diaphragm. The movements of the diaphragm are thus imparted to the transmitting device through the medium of these levers, whose point of contact, and hence whose ratio of movement, shifts in proportion to the amplitude of the sound vibrations.

The instrument may be so adjusted that the vibrations of large amplitude cause the point of contact of the levers to shift in such a way that the movement imparted to the transmitting device is less than the excursion of the diaphragm, while when the diaphragm

vibrates feebly the motion imparted through the levers to the transmitter shall be magnified.

The invention may be applied not only to transmitting but to receiving telephones. In its use in the latter instrument its function may obviously be to mechanically magnify or exaggerate the degraded harmonic pulsations while diminishing the fundamental vibrations, thus in a manner restoring the transmitted impulses to their original condition.

I have illustrated the invention in the accompanying drawings, having shown its application to both a receiving and a transmitting telephone.

Figure 1 of the drawings is an elevation of the essential parts as applied in a receiving-telephone. Fig. 1ª is a partial plan view of the instrument shown in Fig. 1. Fig. 2 is a sectional view of the same device in use with a transmitter of the granular carbon type. Fig. 3 illustrates a transmitter such as shown in Fig. 2 connected in an electric circuit with a receiving-instrument like that shown in Fig. 1.

The receiving-telephone in Fig. 1 comprises the permanent magnet a, carrying on its pole-pieces coils a^2, an armature b for the magnet, a diaphragm c, and a system of compensating-levers and mechanical connections between the diaphragm and the armature. The armature b itself is used as one of the compensating-levers. A lever d co-operating with this is the other. Armature b is lightly supported upon a knife-edge b^2, being held in place by link b^3. Between the pole-pieces of magnet a lies a lever d, which is supported at its upper extremity on a light spring d^2, fixed in a bracket e. The surface of the lever d which abuts upon the face of armature b is curved, so that as the armature rotates about its pivotal point b^2 the point of contact between the parts of contact b and d is shifted toward or away from the fulcrum b^2. The yielding spring d^2 permits to the lever d a sufficient longitudinal movement to avoid the sliding of its surface upon armature b and consequent friction. This last-described device for eliminating or largely reducing the friction which would arise from the tendency to a relative longitudinal movement between the levers constitutes the subject of another application. The free extremity of lever d is connected by a thin wire f with the center of diaphragm c.

Referring to Fig. 2, it will be seen that the novel features of the telephone shown there comprise essentially the same parts. The diaphragm h is connected through a wire i with one extremity of the curved lever k, whose other extremity is carried upon a yielding support l. The convex surface of lever k bears upon the flat surface of another lever m, supported on a spring n, the free extremity of the lever m being connected through a rod o with the movable carbon plate or electrode p of the transmitting device q. This latter part may be of any well-known construction. It may have a small diaphragm q^2 carrying the electrode p, and constituting the cover of a cup-shaped receptacle containing granular carbon q^3 and having fixed to its wall another electrode q^4.

The operation of these instruments may be described in connection with Fig. 3, in which a transmitting-telephone is represented in a circuit 1 2 3, extending between two stations r and s. In this figure the levers are represented as being so adjusted that the point of contact between them is substantially intermediate of the point of connection with the diaphragm and that of connection with the transmitting device q. In this case the feeblest vibrations, which disturb the diaphragm to the slightest extent, will not be perceptibly magnified. A slight vibration of the diaphragm to the right will obviously rotate the lever k about its support l, and this movement will be communicated to lever m and thence to the movable electrode in the transmitter q. A large excursion of the diaphragm, however, will produce a large movement of lever k to the right, whereby the point of contact between that lever and lever m will be shifted to a place nearer the fulcrum of lever k and farther from that of lever m, so that the movement of the electrode q^2 will be less than the excursion of the diaphragm. The vibrations imparted to this electrode will hence be of less amplitude than the original sound vibrations, and the amplitude of the undulation produced in the current by the change of resistance in transmitter q will be of correspondingly reduced proportion.

If desired, the instrument may be so adjusted that the normal point of contact between levers k and m is farther from the fulcrum of lever k and nearer that of lever m. Obviously, with such an adjustment the feeble vibrations, which disturb the diaphragm only slightly, would be magnified, the corresponding vibrations imparted to the transmitter-electrode from the extremity of lever m being of greater range than those of lever p. Thus the undulations of current in the circuit corresponding to fundamental acoustic vibrations would remain in direct proportion to the acoustic vibrations, while the amplitude of the harmonic vibrations would be magnified. At the receiving-station s also the instrument is adjusted to reproduce the minute vibrations in their normal proportions and the coarser vibrations in reduced proportions. A heavy pulsation through coil a^2 will so reduce the attraction of the permanent magnet upon its armature b that the latter will move outward, and hence will shift its point of contact with lever d nearer to the fulcrum of lever b and away from the fulcrum of lever d, reducing the movement imparted to the diaphragm through wire f.

If the conductor 2 were a cable character-

ized by high static capacity and absorption, the transmitting-instrument might be so adjusted as exactly to compensate for the degradation or modification experienced by the undulatory current in traversing the cable—that is, the transmitter would be adjusted to such a relation between levers *k* and *m* that the overtones would be just sufficiently magnified to compensate for their increased liability to absorption or obstruction, the fundamental tones being somewhat diminished in volume. This distorted transmitting-current would then result in a current at the distant station *s*, whose fluctuations would be exact counterparts of the original acoustic vibrations.

The invention is of course subject to modifications and improvements which will occur to those skilled in the art.

I claim, broadly, as new and desire to secure by Letters Patent—

1. In a telephone the combination with a diaphragm and a device adapted to vibrate therewith, of a system of compensating levers interposed between the diaphragm and the said device and adapted to alter the ratio between vibrations of large amplitude and those of small amplitude, as described.

2. The combination with the diaphragm and a current modifying device adapted when vibrated to produce an undulatory electric current, of a mechanical device interposed between the diaphragm and the current-modifying instrument adapted to alter the proportion between vibrations of large amplitude and those of small amplitude, as described.

3. In a telephone the combination with a diaphragm and a current-varying device, of a system of levers interposed between the diaphragm and the said device adapted to transmit vibrations of large and of small amplitude from the diaphragm to the said device in varying proportion to each other, as described.

4. The combination with a diaphragm and a device adapted when vibrated to produce an undulating electric current, of a system of compensating levers interposed between the diaphragm and said device and adapted to impart a magnified movement to the said device when acted upon by feeble vibrations of the diaphragm, or a diminished movement when subjected to heavy vibrations of the diaphragm as described.

5. In combination in an electric circuit, a transmitting telephone having its diaphragm connected with a current varying device through the medium of a system of compensating levers, and a receiving telephone having a movable armature, and a diaphragm connected therewith through a system of compensating levers, said systems of levers being adapted to alter the ratio between vibrations of large amplitude and those of small amplitude, as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 24th day of July, 1895.

STEPHEN D. FIELD.

Witnesses:
FRANK R. MCBERTY,
FRANK C. LOCKWOOD.