

No. 638,152.

Patented Nov. 28, 1899.

J. S. STONE.
TELEPHONY.

(Application filed Dec. 15, 1896.)

(No Model.)

Fig. 1.

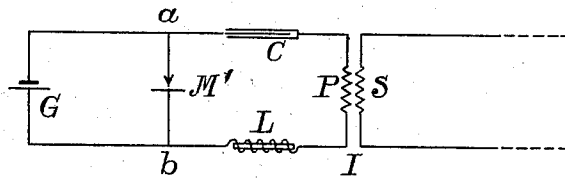


Fig. 2.

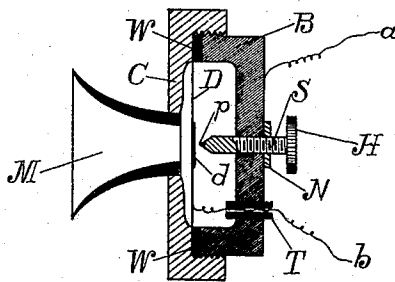
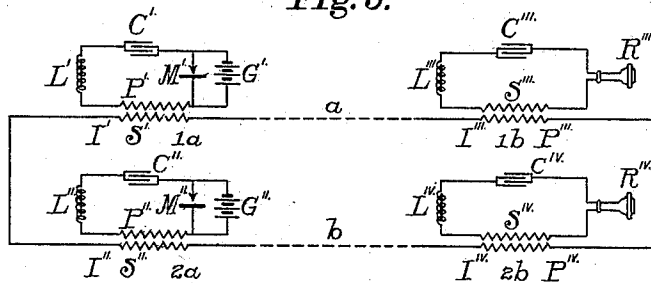


Fig. 3.



Attest.

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TELEPHONY.

SPECIFICATION forming part of Letters Patent No. 638,152, dated November 28, 1899.

Application filed December 15, 1896. Serial No. 615,776. (No model.)

To all whom it may concern:

Be it known that I, JOHN STONE STONE, of Boston, Massachusetts, have made a new and useful Improvement in Telephony, of which the following is a specification.

My invention is a new means of reproducing and transmitting to a distance articulate speech and other sounds by varying the amplitude of a vibratory electric current whose initial frequency of vibration is greater than the pitch number of the tone or tones to be so reproduced.

When a telephone-receiver is subjected to a uniform vibratory current whose frequency of vibration corresponds to a tone of a pitch above the limit of audibility or corresponds to a tone of a pitch higher than the highest tone to which the moving parts of the receiver are capable of responding, the telephone remains silent. When, however, the intensity or amplitude of the high-frequency current to which the receiver is subjected is not uniform, but is subjected to slower periodic vibrations whose frequency corresponds to the pitch of an audible tone or combination of tones to which the moving parts of the receiver are capable of responding, the receiver reproduces the tone or combination of tones.

In the present invention the high-frequency current is developed by the disruptive discharge of a condenser in a sonorous circuit, and the required variations in the amplitude of this high-frequency current are obtained by varying the length of the spark-gap at which the disruptive discharge takes place.

In the accompanying drawings, Figure 1 shows, diagrammatically, an arrangement for carrying this invention into effect. Fig. 2 represents in section a form of transmitting apparatus which may be advantageously employed in carrying out my invention, and Fig. 3 is a diagrammatic view showing an arrangement of circuits by means of which the invention may be applied to selective and multiple telephony.

In Fig. 1, G is a generator. C is a condenser. L is an electromagnetic resistance. I is an induction-coil having the primary helix P and the secondary helix S, and M' is the spark-gap, across which the oscillatory dis-

charge of the condenser takes place, the length of which spark-gap is capable of being varied in proportion to the sound-waves of the tone or tones to be reproduced and transmitted.

Fig. 2 represents in section a form of transmitting apparatus which may be considered to give more in detail the spark-gap M'. (Shown in Fig. 1.) B is a cup-shaped metal base which supports on its rim the metal diaphragm D. The diaphragm D is insulated from the rim of the cup B by the intervening ring W of insulating material and is held in position by the cap C of insulating material, which screws down upon the base B and binds the diaphragm between it and the insulating-ring W. M is a mouthpiece of hard rubber or other suitable material, which screws or fits into the face of the cap C. At the center of the inner surface of the diaphragm D is secured a platinum disk *d*, opposite which is placed a platinum point *p*. This point *p* is mounted at one end of a metal support S, which screws into and through the back of the metal cup B and terminates at the other end in the milled head H, by which it may be rotated. When the apparatus is adjusted for operation, the head H of the screw-support S is turned till the point *p* is very close to the plate *d* on the diaphragm D, leaving only a very small space as the spark-gap. Then the nut N is turned till it binds against the surface of B, and in this way the adjustment is rendered secure from changes due to accidental rotation of the screw S. The platinum point *p* is conductively connected through the support S and base B to the wire *a*, secured to the latter, whereas the disk *d* on the diaphragm is conductively connected with the wire *b* through the diaphragm D, to which the wire is fastened. The wire *b* passes through a hole in the base B, which is heavily bushed with some suitable insulating material, as shown at T.

Fig. 3 shows an arrangement of circuits by means of which this invention may be applied to selective and multiple telephony. In this diagram four stations 1^a, 1^b, 2^a, and 2^b, are shown associated with a main telephone-line *a b*. The station 1^a is adapted to communicate to the station 1^b and the station 100

2^a to the station 2^b. For this purpose the sonorous resonating-circuit at 1^a and the resonator-circuit at 1^b are attuned to the same frequency, while those at 2^a and 2^b are attuned to some other frequency. The organization of the circuits at each of the transmitting-stations is similar to that shown in Fig. 1. I', I'', I''', and I^{IV} are induction-coils having, respectively, the primary windings P', P'', P''', and P^{IV}, and the secondary windings S', S'', S''', and S^{IV}. C', C'', C''', and C^{IV} are condensers. L', L'', L''', and L^{IV} are inductance-coils. G' and G'' are current-generators. R' and R'' are telephone-receivers, and M' and M'' are spark-gap devices.

In the operation of the organization shown in Fig. 1 the generator G charges the condenser C till the potential difference at the spark-gap M' is sufficient to overcome the dielectric strength of the intervening medium when a disruptive discharge takes place at that point. When such a disruptive discharge takes place, the resistance at that point becomes abruptly and enormously diminished. Owing to the resistance of the generator G or, more generally speaking, to the impedance of the circuit M a G b, the potential difference at M immediately becomes quite insignificant. By virtue of the electromagnetic inertia of the circuit M a C P L b the condenser C overdischarges till it receives a charge in the opposite direction almost equal to the initial charge. The spark then ceases to pass across the space at M', and the generator G proceeds to charge C in the initial direction till the potential difference at M is again sufficient to produce a disruptive discharge at M', when the above-mentioned cycle is repeated. In this way a uniform oscillatory current of inaudible frequency is developed in the primary circuit, including the primary helix P, which oscillatory current is impressed upon the main circuit by means of the induction-coil I. The frequency of this oscillatory current is determined by the electromagnetic, electrostatic, and dissipative resistance of the primary circuit. The potential difference to which the plates and the condenser C may be charged before a disruptive discharge takes place across the spark-gap M' depends upon the length of the air-gap, and the current necessary to charge the condenser is proportional to this potential difference between the plates. It follows that by varying the length of this air-gap I may vary the amplitude of the oscillatory current in the primary circuit. This feature is made use of in reproducing sound, the length of the air-gap being varied in proportion to the sonorous vibrations of the sound to be reproduced and these variations being reproduced in the amplitude of the current in the main circuit. The system operates in the same manner where the primary P is in the branch containing the spark-gap instead of being in the

branch containing the condenser C, and the reason for this is readily seen from a consideration of the manner of operation in the former arrangement.

In the operation of the spark-gap device shown in Fig. 2 for the transmission of speech the words are uttered before the mouthpiece M. The sound vibrations resulting therefrom impinge upon the diaphragm D, setting it into corresponding motion and so varying the length of the spark-gap between the plate d and point p.

In the arrangement shown in Fig. 3 the principle of operation of the two transmitting-circuits 1^a and 2^a is the same as that described above for the circuit shown in Fig. 1. When in simultaneous operation, each transmitting-station induces in the main telephone-line a b a vibratory current of high but different frequency. Each of these vibratory currents of high frequency has its amplitude varied in proportion to the sound-waves of the voice of the particular speaker who is talking into the mouthpiece of the spark-gap device at the station where the currents of this particular frequency are developed, and each of these high-frequency currents whose amplitude is so modified induces a current of corresponding frequency and modified amplitude in the particular one of the receiving-circuits which is attuned to its frequency or rate of vibration. The rate of vibration of each of these currents is so great as not to produce an audible sound in the telephone-receivers, but the latter respond to the variations in the amplitude of these vibrations, and therefore each receiver reproduces the sound of the voice which controls and varies the spark-gap in the circuit at the particular transmitting-station where vibratory currents of the frequency to which the receiving-circuit is attuned are generated. The frequency of the current developed by the transmitting sonorous circuits is determined by the self-induction and capacity of the circuit including the primary of the induction-coil, the inductance-coil, the condenser, and the spark-gap, and by properly proportioning this self-induction and capacity any desired frequency between very wide limits may be obtained. The attuning of the receiving-circuits is likewise accomplished by proportioning the inductance of the secondary circuit to the capacity of the condenser located in the secondary circuit.

For the proper operation of sonorous circuits and of resonant circuits generally it is of the greatest importance that the inductance and electrostatic capacity of the circuit be of the elastic type, and for this purpose dielectric and magnetic hysteresis, Foucault currents, and closed secondary reactions generally should be avoided or minimized by any means best adapted for the purpose.

I claim—

The herein-described method of transmitting articulate and other sounds by developing a uniform oscillatory current of inaudibly high frequency in the primary of a telephone-circuit by the disruptive discharges of a condenser in said primary, and varying the length of the spark-gap across which such disruptive discharges occur in accordance with the sonorous vibrations of the sounds. 10

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Witnesses:

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THOMAS D. LOCKWOOD.