(No Model.) 2 Sheets—Sheet 1.

J. ABSTERDAM.

ART OF AND APPARATUS FOR TRANSMITTING SPEECH.

No. 538,474. Patented Apr. 30, 1895.

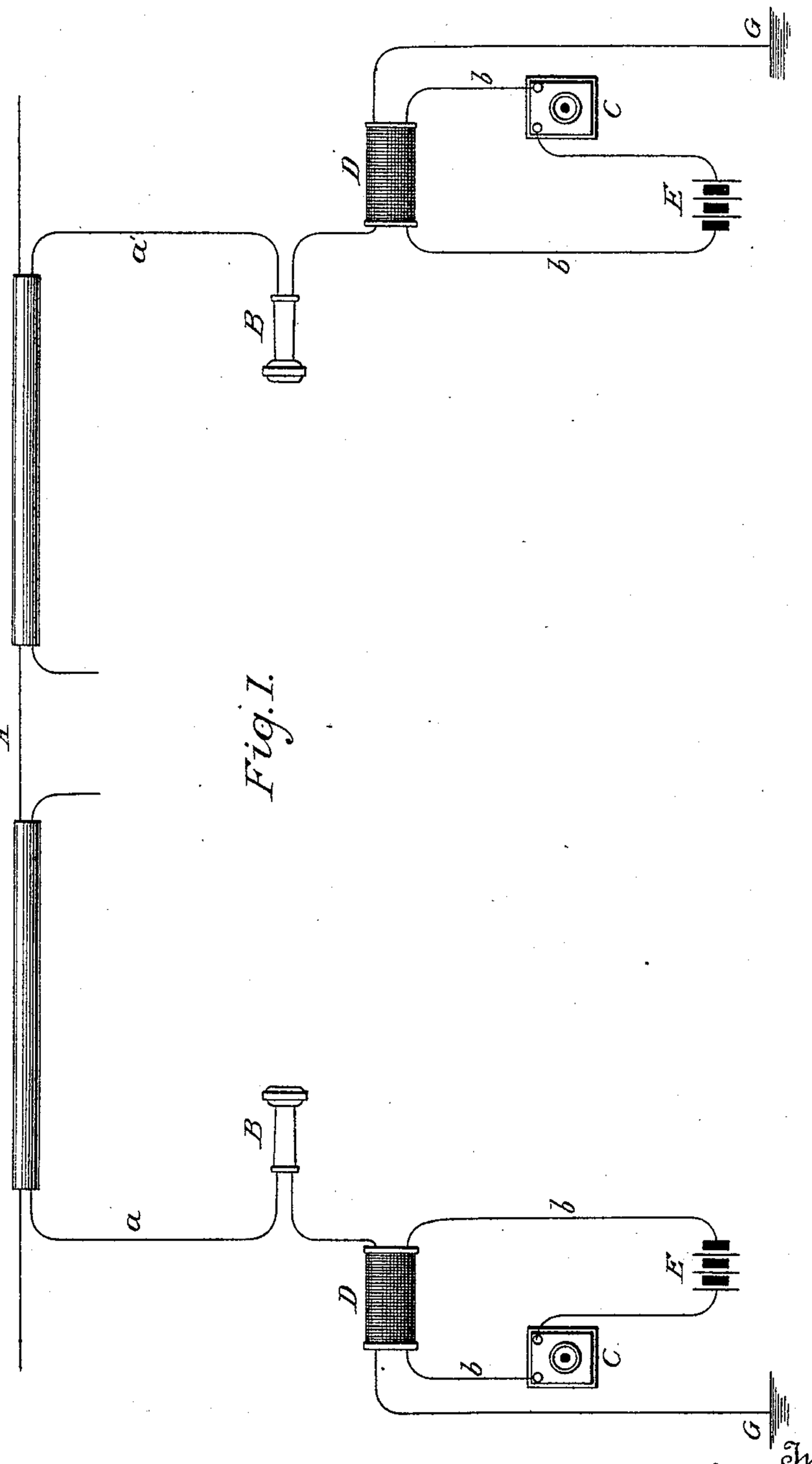

Fig. 1.

Witnesses
Raymond A. Barnes.
P. V. Dodge

Inventor
John Absterdam

(No Model.) 2 Sheets—Sheet 2.

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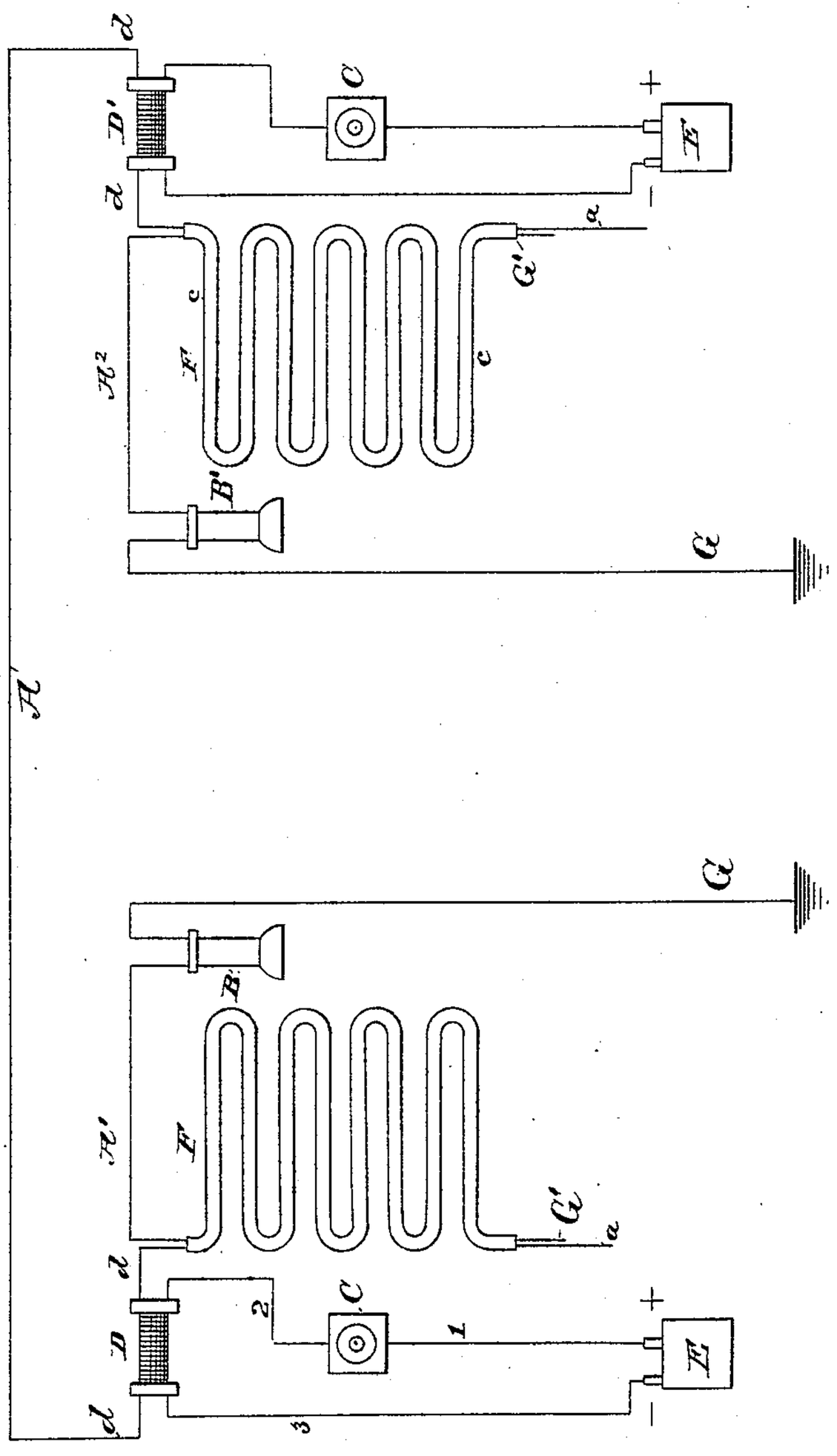
No. 538,474. Patented Apr. 30, 1895.

Fig. 2.



Attest;
W. H. Benjamin
Francis B. Kyle

Inventor;
John Absterdam

UNITED STATES PATENT OFFICE.

JOHN ABSTERDAM, OF NEW YORK, N. Y., ASSIGNOR, BY MESNE ASSIGNMENTS, OF THREE-FOURTHS TO A. WILFORD HALL, OF SAME PLACE.

ART OF AND APPARATUS FOR TRANSMITTING SPEECH.

SPECIFICATION forming part of Letters Patent No. 538,474, dated April 30, 1895.

Application filed February 18, 1891. Serial No. 381,927. (No model.)

To all whom it may concern:

Be it known that I, JOHN ABSTERDAM, of the city, county, and State of New York, have invented centain new and useful Improvements in the Art of and Apparatus for Transmitting Articulate Speech Through the Medium of an Open Line Wire, of which the following is a specification.

Briefly speaking, my invention may be said to consist in electrically transmitting articulate speech or articulate sounds over an interrupted circuit or in other words, over a line which at one or more points is permanently "open;" by which I mean that the parts of the line wire or circuit while brought into such proximity or relation as to be capable of use as a circuit or medium for transmitting speech electrically, shall be nevertheless incapable of use for transmitting telegraphic signals magneto calls or for other telegraphic transmission. The main advantage which I derive from this system of telephony is that I remove to a great extent the electrical disturbances called induction currents from the proximity of lines carrying currents for telegraph, electric light, or power purposes, and which interfere with telephonic transmission.

In fact by my invention of using for telephonic transmission, a line which is "open" for any telegraphic transmission or for magneto call-signals or other electric signaling, I so far eliminate the electrical disturbances from the vicinity of electric lines or from the earth, that lines which without my system are entirely useless for the electrical transmission of articulate speech, may be successfully employed with my invention.

In carrying out my invention, I by preference, construct my line constantly "open" at its terminals, by bringing the terminals of the two broken portions of the line wire or broken circuit near each other by overlapping one part of the broken line circuit upon the other without contact or connection of any kind, but their electric proximity or relation must be such, that no signal-bell or magneto call could be rung over the "open" line or interrupted line circuit, although the electric speaking telephone impulses will be transmitted. If the electric relations be such that magneto calls may be transmitted from one overlapping wire to the other forming the "open" line or interrupted circuit, then the line is useless for the purposes of my invention, because then the electrical transmission of speech can be seriously affected by induction currents from neighboring electrical lines or by other foreign dynamic electricity. I, therefore, wish to disclaim any electric relation of the two portions of interrupted circuit that anything but speech may be electrically transmitted.

I am aware that in systems of telephony condensers have been employed interposed in the line circuit, but what are technically or commonly called condensers are not suited to the purposes of my invention, because so far as I am aware they are adapted to transmit magneto calls, or telegraphic signals from one portion of the circuit to the other, and in most of the prior systems of which I am aware that use of them, is made necessary through the absence of other means or circuits for calling from one station to another. In my system, however, another and distinct ground circuit or connection are employed for the magneto or other call, but such connections are omitted in the drawings.

I am also aware that it has been proposed to use in a cable two distinct conductors insulated from one another by an insulating coat such as are used in cables for submarine telegraphy, but it is stated however, that said cable is a condenser, and that it is to be used for the transmission of telegraphic messages as well as telephoning by using the cable as a condenser. As before pointed out, the use of condensers through which telegraphing signals may be transmited is outside of my invention.

I am also aware that it has been proposed to wind long insulated wires together on a bobbin and place them connected as a shunt to telegraph instruments in an ordinary telegraph line, as in the patent to Langdon-Davies, No. 351,367, dated October 26, 1886, for the purpose of permitting the use of an ordinary telegraph line to simultaneously transmit ordinary telegraph signals and harmonic signals, and also for simultaneously telegraphing and

telephoning on the same telegraph line; but the said Langdon-Davies invention differs from mine, because not only must the instrument allow additional telegraphic service, but it also is the only medium provided over which one telephone station may call another by ordinary telegraphic signals, over the same line circuit as his line is grounded at both ends the same as all other ordinary aerial telegraph lines; and moreover the line circuit of Langdon-Davies is a closed telegraphic line with batteries in the line circuit as other ordinary telegraph line, which would allow the very induction currents to flow upon the line, which it is the aim of my invention to prevent, by making the interruption of the line circuit such as to allow only the transmission of speech electrically, for all of which reasons the line of Langdon-Davies is not an open line or interrupted line circuit, as it is simply an ordinary telegraph line with a new way of shunting the ordinary Morse telegraph instruments.

In the accompanying drawings, Figure 1 is a diagram illustrating one of my improved "open" or interrupted telephone line-circuits in accordance with my invention. Fig. 2 is a diagram illustrating a modification of the same, both in their simplest form, with the call-bells, switches, and signaling ground-circuits omitted.

It will be obvious that in carrying my invention into effect, there may be more than one permanent interruption in the line circuit; but I prefer using a continuous main line wire extended from one telephone station to another, including the secondary wire of an induction coil at each station, and there terminating with "open" ends, without ground connections or other connections whatever.

At each terminal station, I use a station wire with one of its ends connected to the earth, and then extended longitudinally adjacent to the "open" terminal of the main line wire, without metallic contact between them; and both wires being extended adjacent to each other to a suitable length. They may be naked or covered and bent or coiled in any suitable way, and terminating with "open" ends, and without metallic contact between them. The telephone receivers at each station, may be included in the station wire or in the main line wire. The primary wire of each induction coil, I include in a local circuit with a microphone and a battery.

The length of the portion of each terminal of the main line wire and of the station wire extended adjacent to each other, must be ascertained by actual experiment as a greater length is required for a short telephone line than for a long line, and a shorter length is required when wires of a large diameter are used, than for wires of a small diameter.

For a telephone line situated among telegraph line wires and forty (40) miles long or more, one and a half ($1\frac{1}{2}$) pounds for each wire of No. 20 wire gage, may be sufficient, which is about 269.83 feet long, per pound and three (3) pounds for each wire of the same gage, may be required for short telephone lines such as are used in cities. The length of the wires adjacent to each other thus required for a short telephone line, may be said to be one half more than the length required for a long line, or in other words, the capacity of each wire thus required for a short line, may be said to be one half more than the capacity required for a long line, which is the reverse of a condenser, as the rule used in making condensers is, that a condenser should have the same capacity as the line. As my telephone line thus constructed has its circuit constantly "open" at its terminals, the induction currents or other foreign dynamic electricity coming to the telephone line wire cannot flow thereon. Consequently such foreign electricity in such condition on the line, does not prevent the transmission of articulate speech, even if my line was situated among a great multitude of telegraph line wires.

When articulate speech or articulate sounds are uttered at the microphone in the primary circuit of the induction coil at either station, the vocal sounds acting on the local battery current through the medium of the electrodes of the transmitter produce electrical sound waves, which are communicated or transmitted through the medium of the electrified line wire to the distant telephone receiver, by which the sound waves are faithfully reproduced at the opposite end of the line; and the stronger the electrification of the line wire without flowing currents, the stronger are the electrical sound waves over the line.

Referring to Fig. 1, A represents a line wire extending from one telephone station to another, and there terminating with both end constantly "open" without ground connections or other connections of any kind. *a* and *a'* represent two conducting station wires located at their respective terminal stations, each extended to a suitable length adjacent to the terminal of the main line wire, but wholly separated therefrom. The terminal portion of the main line wire and the station wire adjacent to each other may be naked or covered with some non-conducting substance, and they may be bent or otherwise arranged or formed at will, provided only they lie longitudinally near each other with their ends constantly "open" and so separated from one another that it is impossible to operate any telegraph apparatus or magneto current across the space or gap between them. Each of these station wires is connected through an ordinary telephone instrument B, and thence to the secondary wire of the induction coil D, and finally continued to the earth at G. The line proper consists it will thus be seen, of the two terminal stations' wires connected to the earth at one end, then extended alongside of, but separated from, the terminals of the line A, and having their opposite ends constantly "open," the same as the "open" ends of the main line

wire. The induction coil at each station has its primary wire *b*, connected on one side through an ordinary telephone transmitter or microphone C, and thence to one pole of a local battery E, and on the other side said primary wire is connected directly with the other pole of said battery. There is, therefore, at each terminal station a local circuit including a local battery, the transmitter, and the primary wire of an induction coil which coil has its secondary wire continued through the fine wire forming the small coil or helix of the receiving telephone instrument and the "open" ground wire, extended adjacent to the "open" terminal of the main line wire, thereby forming a permanently "open" line circuit at each end of the line. The local circuits are constantly closed during transmission and the local battery current flows, therefore, constantly through the primary wires of the induction coils while speech is transmitted. If now speech be uttered in the presence of either transmitter, the vocal sound waves will influence the local current through the primary wire of the induction coil. The effect of the vocal sound waves on the local current in the primary circuit of the induction coil is such, that it will cause corresponding electric sound waves over the electrified "open" line wire, so that speech uttered into the transmitter C, will be heard and understood in the receiving telephone instrument B, at the opposite end of the line; and this notwithstanding the fact that there is no metallic or other direct connection between the main line wire and the wires in which the receiving and transmitting telephone instruments are located.

In Fig. 2, the main line wire A is a continuous one from telephone station A′ to telephone station A^2, and is connected at each station, with the secondary wire *d*, of the induction coil D, from which it is extended in a serpentine F, or other form without connection to the earth, or to a conductor of any kind, terminating with its ends constantly "open" at *a*, at both ends of the line. At each terminal station, a station wire is laid parallel and adjacent with the serpentine terminal of the main line wire, and being separated therefrom by a non-conducting covering *c*, or otherwise, this serpentine station wire being left "open" or disconnected at one end from anything as shown at G′, but connected at the opposite end of the serpentine with the helix or coil of the receiving telephone instrument B, and extended thence to the earth at G. The primary wire of the induction coil at each station is arranged as in the preceding example in a local circuit 1, 2, 3, with a transmitter or microphone C, and a local battery E. Now, although the main line wire is left constantly "open" at both ends, at both terminal stations, without ground or other connections; and although the station wires containing the receiving telephone instruments are not in metallic connection with the main line wire and have their terminals left constantly "open" at their ends, speech uttered in the presence of either transmitter may be heard and understood in the receiver at the opposite end of the line, through the medium of the electrified "open" line wire.

It should be understood that the insulating covering of the wires adjacent to each other, has nothing at all to do with the transmission of speech, that it only serves to hold the wires near each other without metallic contact; but the covering may be dispensed with as the said wires may be naked by interposing a non-conducting substance between them, which may be done by winding said wires on a reel together with cotton cords in such a manner, that between each wire convolution, there may be a convolution of cotton cord; or one wire may be naked and the other covered with a non-conducting substance. Then both wires may be wound together on a reel; but whether the said wires be covered or naked no magneto call-bells must ring between them, as they must resist the passage of magneto currents. Otherwise, they could not perform the functions of my invention, because if magneto-currents can pass between said wires, induction currents can also pass between them. Consequently, if magneto call-bells can ring between said wires, they are no good for my invention and I do not claim such line for the transmission of speech, but if magneto call-bells cannot ring between said wires, it is my invention; whether such line wire arrangement be called a condenser of another type or anything else; and without regard to the length, diameter, shape or form of said wires, it is absolutely necessary that no magneto call-bells can ring between them. Otherwise, it cannot perform the functions of my invention.

When speech is uttered at the microphone in the primary circuit of the induction coil, whose secondary wire forms part of the line, electrical undulations similar in form to the sound waves produced by the voice are induced in the secondary wire of the induction coil and in the electrified line wire constantly "open" at its ends, which sound waves are reproduced by the distant receiving instrument.

The difference between my invention and the simultaneous "system of telephony and telegraphy" shown and described in the patent to Langdon-Davies, No. 351,367, dated October 26, 1886, is that in his invention a telegraph line is used requiring line batteries, telegraph relays and transmitting keys are used all in the line circuit, and his line is grounded at both ends in the usual way, the same as all the ordinary telegraph lines operated with Morse instruments.

The electrical condition of Langdon-Davies line is the same as in all the ordinary telegraph lines; and the shunting of the telegraph instruments, by the two long wires together wound on a bobbin, perform the functions before done by others by means of condens-

ers; that is to say, the electric current in the line circuit from the line batteries meets a strong resistance in the helices of the relays, which charge the two wires wound on the bobbin, as it does charge condensers when they are used for shunting telegraph instruments, and it is through the electrical charge in storage in the instrument formed of the long wires wound on the bobbin that the line may be used for additional telegraphic service as set out in that patent by harmonic telegraph apparatus over the line, with the electromotive force of the line batteries thereon; just the same as other simultaneous tranmission is effected by means of condensers.

In my method of transmitting articulate speech on an electrified line wire terminating dead "open," without a battery and without being grounded, there is no other resistance in the main line wire but the secondary wires of the induction coils forming a part of the line.

There is nothing in my telephone system for charging the line except the electrification of the "open" line wire by foreign electricity that may get on the line, and held thereon without flowing; because my line wire has no circuit and no telegraphic or harmonic telegraphic-signaling instrument or magneto call-bells, can be operated for ringing on my "open" line shown in the drawings and described in my specification.

I wish to be fully understood, that a telephone line having two such wires wound on a reel and interposed in a telephone line circuit, and connected in the line circuit in such a manner that no magneto call-bells can ring through such wires, is my invention, which is not contained in the line circuit of the Langdon-Davies patent. Consequently, the said patent to Langdon-Davies is outside of my invention, because his "special instrument" is not interposed in his line circuit, and if it was interposed in his line circuit, he could not telegraph on his line at all. The functions of said "special instrument" used as a shunt to the telegraph instruments, is the same as when condensers are used for that purpose; and said Langdon-Davies line circuit is the same as all ordinary telegraph lines, with batteries in the line circuit and the line is grounded at both ends in the usual way.

In order to ascertain whether the break of line circuit is suitable for my invention, I wind the two said wires on a reel in the manner before described, and connect one end of one of these wires to one of the poles of a magneto-ringer, and connect one end of the other wire to the other pole of said magneto, the other two ends of said wires being left "open" and separated from each other. If when the crank of the magneto is turned with a rapid motion the call-bells remain silent, said wires are proper for use in the line circuit for carrying out my invention; but if the call-bells ring when the magneto's crank is turned, they are not suitable. After said wires have been tried by the magneto, and found to prevent the call-bells from ringing, they may be interposed in the line circuit of an ordinary telephone line by disconnecting the line wire or the ground wire from one of the poles of the magneto ringer, and connecting one end of one of said wires in its place, and connecting one end of the other wire, to the end of the disconnected either line wire or ground wire, the other ends of said wires being left permanently "open" and separated from each other. Care must be taken in interposing said wires in the line circuit, that they should be cut out from the main line wire together with the telephones when the magneto call-bells are to line, and cut in together with the telephones, when the magneto call-bells are cut out from the line, by the usual switching apparatus. Said wires must be interposed in the line circuit at the terminals of the line, and never at a distance from the line switches, as no magneto calls could be transmitted over the line if said wires should be in the line circuit between the telephoning stations.

My line must always be "open" in its terminals in order that said wires may be switched in, and out, of the main line together with the telephone receivers.

I generally provide the magneto call-bells with special ground connections for ringing purposes, but these are not shown in the drawings.

What I claim as my invention is—

1. The herein improved art of transmitting articulate speech electrically over a line circuit substantially such as set forth permanently "open" or incapable of use for telegraphic service and without ground connections as described.

2. A line for electric telephone transmission formed in two or more "open" circuit sections extended adjacent to one another at their ends, but at all times disconnected from one another and from ground during telephone transmission and in such electric relation as described, as to be incapable of use for telegraphic service or for sending calls from one section to the other.

3. In an electric telephone system, a continuous single main line wire including the secondary wires of induction coils and having each open circuit terminal extended adjacent to a ground wire terminating with an open end as described, the primary of the induction coil being in local circuit with a microphone and battery as set forth.

In testimony that I have invented the above I hereby affix my signature this 5th day of February, A. D. 1891.

JOHN ABSTERDAM.

Witnesses:
EDW. B. HAWKINS,
FRANCIS C. NYE.