(No Model.)

C. E. SCRIBNER.

SYSTEM OF CURRENT SUPPLY FOR TELEPHONES.

No. 559,616. Patented May 5, 1896.

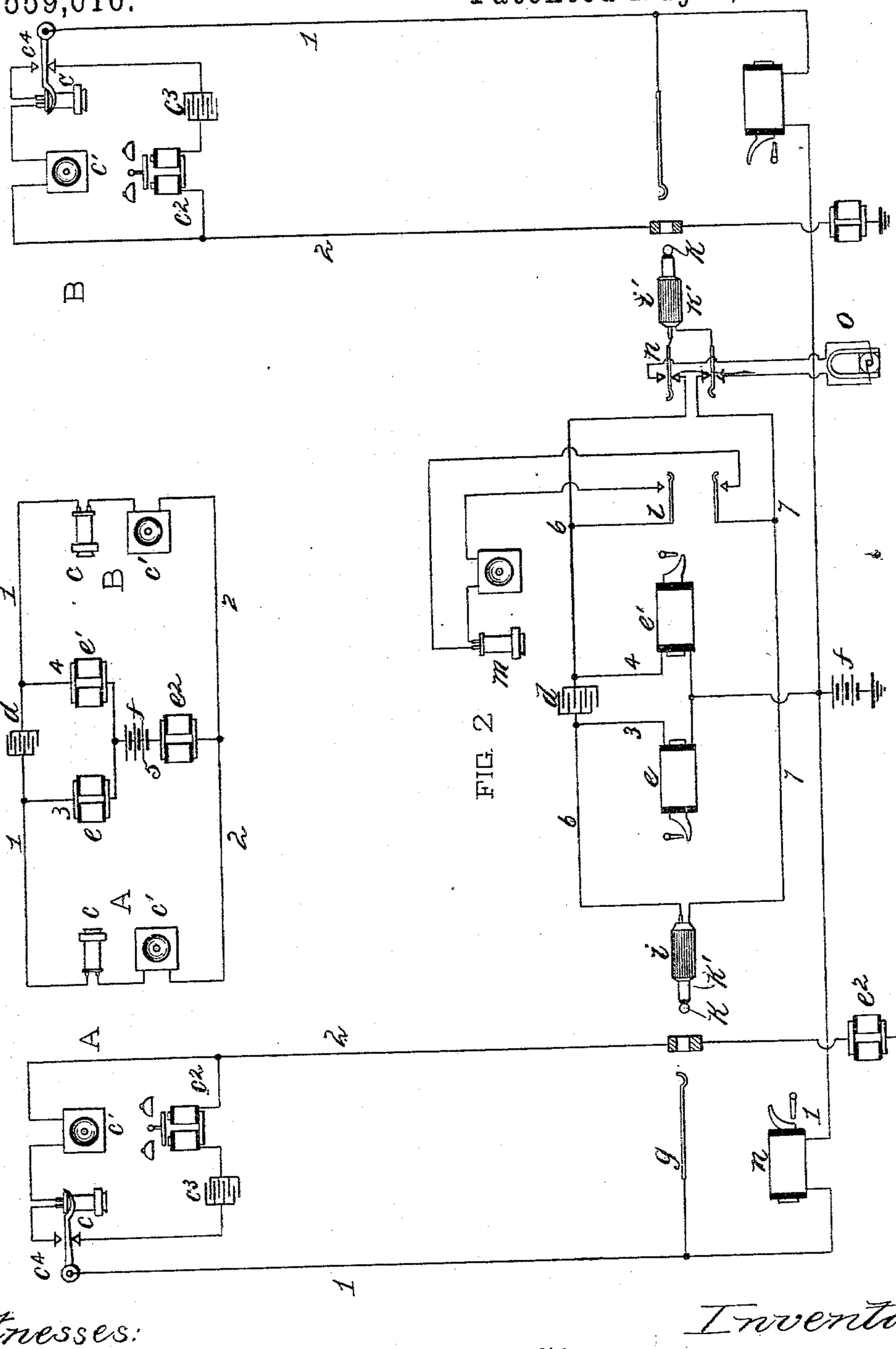

FIG. 1

FIG. 2

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CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF SAME PLACE.

SYSTEM OF CURRENT SUPPLY FOR TELEPHONES.

SPECIFICATION forming part of Letters Patent No. 559,616, dated May 5, 1896.

Application filed January 8, 1895. Serial No. 534,211. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Systems of Current Supply for Telephones, (Case No. 373,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone-exchange systems in which the substation-microphones are supplied with current from a common source located at the central station or other convenient point. Its object is to provide a simple and efficient system for supplying current in which cross-talk or telephonic interferences between different lines of the system shall be eliminated and the difference of potential between the terminals of either of two connected lines shall be rendered independent of the resistance or electrical condition of the other line. A secondary object is to provide for independent signals in the circuits of telephone-lines adapted to be automatically operated by the alteration of the circuits at the substation in the use or disuse of the telephone.

In my invention I interpose a condenser in the conductor ordinarily employed for uniting telephone-lines in a telephone-switchboard, and I connect the common source of current supply with the severed portions of this conductor through impedance-coils. A steady current is thus permitted to flow from the source of supply through either impedance-coil to the corresponding portion of the conductor uniting the lines, and thence through the substation-microphones included in the lines. The variations caused by one substation-microphone in the current through it are propagated, through the medium of the condenser in the conductor uniting the lines, through the other line-wire and the telephone in its circuit, their transmission through the impedance-coils being obstructed by the self-induction of the coils. Obviously if the source of current supply be of comparatively low internal resistance the volume of current in either line is independent of the resistance in the other line, since the conductors of the line are separated as to the steady currents in their circuits by the condenser. Hence if a short and long line be coupled together the instruments in the long and high-resistance line are not deprived of current for their proper operation by the shunt-path through the lower-resistance line. At the same time the electrostatic impulses which are propagated from one line through the condenser to the other line are found to be but slightly dependent, within certain wide limits, upon the resistance in their circuit.

It has been found desirable in practice to provide signals in connection with the line-circuits which shall be automatically controlled by the position of the telephonic apparatus at the substations, their indicators being displayed or concealed as the telephone is brought into use or returned to its normal position. Such signals ordinarily comprise a line-signal permanently connected with each line, which is adapted to display its indicator when the telephone is removed from its switch-hook for use, and a pair of clearing-out signals in each loop-conductor for uniting telephone-lines, the two clearing-out signals of each plug-circuit being adapted to operate independently, each serving to notify the operator of the replacement of the telephone of the line with which it is more directly connected.

A feature of my invention consists in the combination, with the before-described system of current distribution, of line and clearing-out signals. I connect with each line, as heretofore, a line signal or annunciator of considerable resistance, the free terminal of the signal being connected to one pole of the source of electric current which it is designed to employ in supplying the substation-microphones; and I provide the impedance-coils of the current-supply system with suitable mechanism for operating indicators, thus converting them into signaling instruments. The impedance-coils are constructed to have comparatively low ohmic resistance, whereby, when they are brought into circuit with telephone-lines, the current through the line-sig-

nal is shunted and the latter returns to its normal position.

In the idle condition of the line the line-signal remains inert, the line-circuit being open at the substation. When the apparatus there is brought into position for use, as by removing the telephone from its switch-hook, the line-circuit is closed through the telephone and microphone and the line-annunciator is operated by the current which finds circuit through it from the common battery or other source of supply. When connection is made with the line in the usual way, the line-signal is shunted and becomes again inert, the clearing-out signal is displayed, and suitable current for operating the substation-microphone is put upon the line. Upon the return of the substation apparatus to its normal position the clearing-out signal signifies this condition.

Hitherto it has been necessary to include the clearing-out signals directly in the line-circuit, in which position their impedance and resistance have been detrimental to telephonic transmission. In the arrangement which I have invented, however, it will be noted that independence of operation of the signals is secured, while their resistance is eliminated from the telephonic circuit. At the same time a simple and particularly effective mode of rendering the line-signal inert and insuring its return to its normal condition is provided.

I am aware that it is not new in the art of telephony to supply current for operating substation-microphones to different lines from a common source through different impedance-coils, the lines being united by a continuous conductor; and also that it is not new to connect a source of current with two different portions of a continuous line-circuit through different signals, a condenser being interposed in the circuit between the points of connection of the different signals in a system for signaling purposes alone. I believe myself to be the first, however, to discover the possibility of producing in a telephone-line a steady current by connecting a source of supply through a coil having sufficient impedance to prevent the passage of telephonic currents and of permitting variations in the current of the first line and propagating them in another line through the medium of a condenser, and to bring the condenser and signals into such relation that they exercise their functions coöperatively in the different systems.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 represents the circuits of the system of current supply alone, the two substations being shown in a continuous metallic circuit which is provided with circuits and apparatus in accordance with my invention for supplying current to the substation-microphones. Fig. 2 represents the combined system of current supply and automatic signaling, the apparatus being shown in connection with the usual mechanism of a telephone-switchboard.

In the simple system shown in Fig. 1 each of the substations A and B is equipped with a microphone c' and a telephone c, these instruments being included in series in a metallic circuit 1 2. A condenser d is included in the conductor 1 at a point which may be the central section. From each side of the condenser branches 3 4 are taken, including impedance-coils e and e'. These branches are connected with one pole of a battery f, whose other pole is connected by a conductor 5, including another impedance-coil, with the line-wire 2. As many line-circuits may be connected with the single battery f as desired, the connections being taken through branches similar to 3, 4, and 5, including impedance-coils. The condenser d may be of one microfarad capacity and the impedance-coils may each be of ten or fifteen ohms resistance, or more, if desired.

Obviously the battery f will create through each substation a practically continuous current, the current in either circuit depending solely upon the resistance of that circuit. If sounds are made in one microphone, as c', at station A, the current in the line-circuit to that station is varied in accordance with the varying resistance of the microphone. The fluctuations of this current do not appear to traverse the impedance-coils e and e^2, but rather to be absorbed in condenser d and propagated through the medium of the latter through the circuit to station B. The sound-waves impinging upon microphone c' at station A are thus reproduced in the telephone at station B. Since no perceptible fluctuation takes place in the current through the impedance-coils e, e', and e^2, the battery f may have a considerable internal resistance without the occurrence of cross-talk between the different telephone-circuits connected with it in common.

Referring now to Fig. 2, similar telephonic appliances are indicated at the substations A and B, together with a signal-bell c^2, a condenser c^3 in circuit with it, and a telephone switch-hook c^4, from which the telephone is normally suspended, the switch being adapted to connect the telephone and the bell alternately in the line-circuit as the telephone is removed from or replaced upon its support. The line-wire 1 from station A is connected with one line-contact of a spring-jack g in a telephone-switchboard at the central station and with one terminal of a signaling instrument h, whose other terminal is connected with one pole of the common battery f. This signal should be of moderately high resistance—as, for example, five hundred ohms—and should be so constructed as to fail to respond to alternating currents such as employed for operating the substation-bells. The line conductor 2 from station A is likewise connected with a line-contact of spring-jack g, and is also connected to earth through

an impedance-coil e^2. The line-circuit from station B is connected with similar apparatus in the switchboard.

At the switchboard a number of plugs, with their accessory circuits and switches, are provided, but one pair being shown, however. The plugs i and i' are constructed each with two contact-points k and k', adapted to register with the two line-contacts of a spring-jack. The tips k of the two plugs are united by a conductor 6 and the sleeves k' by a conductor 7. A condenser d is included in the conductor 6. From the severed portions of this conductor branches 3 and 4 are taken to one pole of battery f, the other pole of the battery being connected to earth. In the branches 3 and 4 signals e and e' are included, the electromagnets of the signals being constructed to have sufficient impedance to permit them to perform the functions of the impedance-coils described in connection with Fig. 1. An operator's listening-key l is furnished to enable the operator to connect her telephone set m with the plug-circuit 6 7, and a calling-key n for looping a generator o of signaling-current, suitable for operating bells c^2, into circuit with plug i'.

When the subscriber at station A desires to converse with the subscriber at another substation—as, for example, at station B—he removes his telephone c from switch-hook c^4, thus permitting the latter to close the hitherto open circuit between conductors 1 and 2 through the telephone c and microphone c'. Current from battery f then finds circuit through signal h and line conductor 1 to line 2, and thence through the impedance-coil e^2 at the central station. The signal is thus excited and indicates the call to the attendant, who in response inserts plug i into the spring-jack g of the corresponding line, at the same time bringing the telephone m into connection with the plug-circuit. Battery f is now provided with a circuit of much lower resistance through signal e and conductor 6 of the plug-circuit to the line-wire 1, returning through the line 2 and impedance-coil e^2. The current suitable for the operation of the microphone is thus obtained at the substation. In the new arrangement of the circuits the impedance-coil e of low resistance is in shunt of the signal h of high resistance, and the latter, being practically short-circuited, becomes inert and returns to its normal position. Having learned the subscriber's order, the operator inserts plug i' into spring-jack of line to station B and depresses the plunger of calling-key n, thus ringing bell c^2 at station B. When the subscriber at this station has responded and has removed his telephone from its switch-hook, the telephonic appliances at the substations are united in a complete metallic circuit, including condenser d, both stations being supplied with current from battery f. Conversation may then take place, as described in connection with Fig. 1. When either telephone is replaced upon its switch-hook, the circuit of battery f through that line is interrupted at condenser c^3, whereby the corresponding clearing-out signal e or e' becomes demagnetized and returns to its inert position, displaying a suitable signal to indicate to the operator the position of the apparatus at the substation. The display of both signals may be interpreted as signifying that the conversation is terminated and the connection between the lines may be removed.

It is found in practice that with the condenser connected in the circuit of the lines between the points of supply of current to them it is possible to employ impedance-coils e e' of less resistance than would be permissible with a continuous conductor in place of the condenser, no appreciable interference between different telephone-lines connected with the common battery being noticeable with low-resistance impedance-coils arranged as herein described. My invention therefore permits the use of a battery of much lower electromotive force than would be necessary to provide the proper volume of current for operating the substation-transmitters if the impedance-coils e and e' were of high resistance, and thus accomplishes transmission with a minimum expenditure of energy in the system of distribution.

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

1. The combination with a telephone-circuit, of a microphone and a telephone in the circuit, a condenser included in the circuit between the microphone and the telephone, and a source of electric current for supplying the microphone connected through a resistance-coil with that portion of the line including the microphone, substantially as described.

2. The combination with a telephone-line, of a microphone included in series in the telephone-circuit at each terminal station of the line, a condenser in the line intermediate of the two stations, a source of electric current and a connection from said source of current through an impedance-coil to the line at each side of the condenser, substantially as described.

3. The combination with a metallic-circuit telephone-line, of a microphone and a telephone in series in the line at each of the terminal stations thereof, a condenser in one side of the line intermediate of the stations, a source of electric current, two branches from one pole thereof through impedance-coils to the same side of the telephone-line at each side of the condenser therein, and a branch from the other pole of the battery to the other side of the telephone-circuit, substantially as described.

4. The combination with a source of electric current, of several complete telephone-circuits, each including a microphone at each of its terminal stations, a condenser in each circuit intermediate of the terminal stations, branches from each side of each condenser to

the same pole of the said source of current, and a low-resistance impedance-coil in each of said branches, substantially as described.

5. The combination with two united telephone-lines, of a microphone and a telephone at the substation of each line, and means for opening the line-circuit or closing it through said telephonic appliances, a condenser included in the link conductor uniting the lines, a source of electric current for supplying the substation-microphones, and an electromagnetic signal in a branch from said source of current to each of said telephone-lines, substantially as described.

6. The combination with a telephone-line, of a microphone and a telephone at the substation thereof, and a switch for interrupting the line-circuit or closing it through the microphone, a source of electric current permanently connected with the line through a conductor including a high-resistance signaling instrument, a link conductor for establishing connection between lines, a branch from said source of current to the link conductor, and a signaling instrument of comparatively low resistance included in the said branch, whereby the high-resistance signaling instrument is practically short-circuited by the low-resistance instrument and the latter is adapted to give a signal, when connection is made with the line.

7. In combination, two telephone-lines each provided with a microphone and telephone at its substation and with a switch adapted to interrupt the line-circuit or to close it through the microphone, a common source of current, a branch from one pole of said source of current to each line through a signaling instrument of high resistance, a link conductor for uniting the lines, a condenser included therein, a branch from the same pole of the said source of current to each side of the condenser, and a signaling instrument of comparatively low resistance included in each of said branches, whereby when connection is made between the lines current is supplied to each line for operating its transmitter, the line-signal of each line is practically short-circuited, and a clearing-out signal is brought into connection with each line, substantially as described.

In witness whereof I hereunto subscribe my name this 7th day of December, A. D. 1894.

CHARLES E. SCRIBNER.

Witnesses:
ELLA EDLER,
LUCILE RUSSELL.