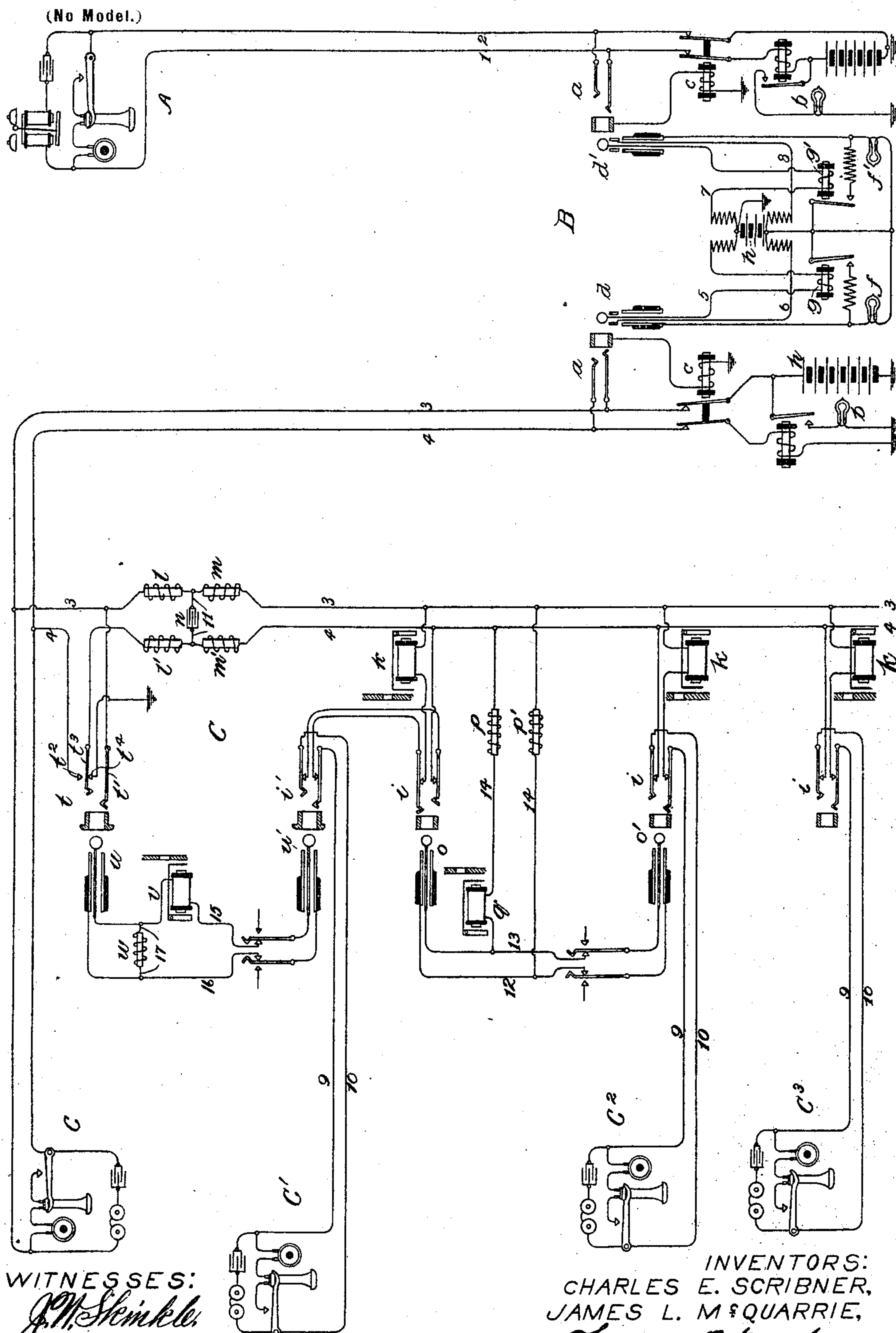


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C. E. SCRIBNER & J. L. McQUARRIE.
TELEPHONE EXCHANGE SYSTEM.

(Application filed Jan. 29, 1900.)



WITNESSES:
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TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 684,111, dated October 8, 1901.

Application filed January 29, 1900. Serial No. 3,096. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. SCRIBNER and JAMES L. McQUARRIE, citizens 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 Telephone-Exchange Systems, (Case Nos. 484 to 488,) of which the following is a full, clear, concise, and exact description.

Our invention relates to the operation of telephone-lines provided with branch or extension lines adapted for connection among themselves or for connection through the medium of the main line with other exchange-lines.

The object of our improvement is to provide means for supplying current from a central source of energy at the central-station terminal of the main line for the excitement of the transmitters and the operation of automatically-controlled signals on both the main line and the extension-lines, while maintaining the independence of the lines for telephonic communication.

The invention consists in the combination, with the main line and the central source of current connected therewith, of means for connecting a telephone directly with the main line at the branch-exchange terminal of the line, connections of the several extension-lines with the main line by which they may derive current from it for their individual operation, means for preventing the propagation of variations produced in the current in the extension-lines into the main line, and means for switching the extension-lines into connection with one another or with the main line.

Our invention is illustrated diagrammatically in the accompanying drawing and may more readily be understood when explained in connection therewith. In this drawing are indicated two main telephone-lines entering a switchboard at a central office where there is located a central source of current-supply and switching apparatus for uniting the main lines and extension-lines at the terminal or branch exchange of one of the main lines with switching apparatus for uniting the extension-lines with one another and

with the main line, the whole being arranged in accordance with our invention.

One of the main lines extends from the substation A to the central office B, the connection being made by means of line-wires 1 and 2 from telephones and a call-bell at the substation to a spring-jack *a*, a signal *b*, and a cut-off relay *c* for the line-signal, all in a switchboard at the central office. The substation C, which is also the branch-exchange station in which the extension-lines center, is likewise connected by line-wires 3 and 4 with similar apparatus in the switchboard. The switchboard in the central office is furnished with pairs of plugs *d* and *d'*, with their uniting plug-circuit 5, 6, 7, and 8. Associated with the terminal plugs *d* and *d'* are supervisory signals *f* and *f'*, which are controlled by supervisory relays *g* and *g'*, respectively, placed in the plug-circuit in the path of currents from the central source *h*, connected in a bridge of the plug-circuit, so that the supervisory signals are responsive to currents determined in the use of the telephone at the substations with which the corresponding plugs are connected. All these appliances are well known in the art of telephony, being those which characterize the so-called "relay-switchboard."

The substation or branch-exchange station C is the center of extension-lines to stations C' C² C³, &c. The circuit and apparatus of the line to branch-exchange station C' alone may be traced, as these are typical. The apparatus at the telephone-substation is like that at stations A and C, being the ordinary equipment for substations of a common battery system. The appliances at the substation of the extension-lines are connected by line-wires 9 and 10 with switch-springs of a cut-off spring-jack *i* in the branch-exchange switchboard. From the normal resting-contacts of this spring-jack the conductors are extended, one through a visible signal *k* and the other directly to extensions of the line conductors 3 4 of the main line. In these extensions of the main line, between the points with which the telephone at station C becomes connected and the points with which the extension-lines are connected, are interposed a

series of two or more impedance-coils, those in the different line conductors 3 and 4 being designated $l m$ and $l' m'$, respectively, and between the serially-connected impedance-coils a bridge 11 of the main-line circuit is connected, which includes a condenser n .

The branch-exchange switchboard, like that in the main exchange, is furnished with pairs of plugs o and o' , the like line-contacts of the two plugs being united by conductors 12 and 13, respectively, which constitute the plug-circuit. This plug-circuit differs from that in the switchboard at the central office, however, in that the branch wires 14 of the plug-circuit lead to the extensions 3 4 of the main line through impedance-coils p and p' , instead of through the windings of a repeating-coil. A visible supervisory signal q is interposed in the bridge 14 of the plug-circuit with one of the impedance-coils.

The plugs o and o' are adapted for connecting together any two of the extension-lines, by means of the spring-jacks i of the extension-lines to unite the lines for local communication. A few lines—as, for example, the line to station C' —may be specially arranged to permit of communication through the main line with other main lines in the central station. For this purpose a special spring-jack i' is connected serially in the line 9 10, which when a plug is thrust into it cuts off the supervisory signal and the other spring-jack of the same line. A similar spring-jack t is connected with the main line 3 4, the line conductor 3 being led to one line-spring t' ; but the line conductor 4 is led to a special contact t^2 , provided for the other line-spring t^3 of the jack, which forms the terminal of the conductor, including the impedance-coils l' and m' , and which rests on a contact t^4 , by which it is normally grounded. The spring-jacks i' and t may be of a different size from the spring-jacks i , so as to require the use of different and special plugs with them. Such plugs are indicated at u and u' . They form the terminals of a special plug-circuit. The tips of the plugs u and u' are united by a conductor 15, which includes a supervisory relay v . The other contact-pieces are directly united by a conductor 16. A bridge-wire 17 is provided, including an impedance-coil w , near the plug u .

It is understood, of course, that the plug-circuits 12 13 and 15 16 may be provided with the usual apparatus by which the operator is enabled to listen in or to send out call-signals. This, however, being well known in the art is omitted from the drawing for the sake of clearness.

While the apparatus at the central station is not in use current is supplied from the battery h , of which one pole is grounded over the line-wire 3 of the main line to the branch exchange C , where it finds circuit through the impedance-coils l and m to the conductors of the extension-lines and of the plug-circuit between plugs o and o' . All these

circuits stand normally open, however. If a subscriber at station C' should require connection locally with another extension-line, he would take his telephone for use, by which the telephone-switch would be permitted to rise and close the normal break in the circuit of line 9 10, allowing current to flow from the conductor 3 through the line-signal k , line-circuit 9 10, to the grounded line-spring of spring-jack t , and thus to earth. This call would be answered by the operator in the usual way by inserting a plug o in the spring-jack i of the calling-line, and the connection would be completed by inserting the plug o' in the spring-jack i of the extension-line called for, after which a ringing current would be transmitted to the called station by means of a calling-key and generator. Insertion of these plugs into the spring-jacks unites the line-wires 9 and 10 of the line to station C' with the line-wires 9 and 10, respectively, of the circuit to the station called for—say station C^3 . It also cuts off the normal extensions of the united lines to their respective line-signals k and to the grounded conductor. A new path for current from the central supply-battery h is now provided, however, from the conductor 3 of the main line through one of the branch wires 14 to conductor 12 of the plug-circuit, where it divides and passes through the two extension-lines in multiple, returning through the instruments at the substations to conductor 13 of the plug-circuit, whence it finds circuit through the other bridge-wire 14 to earth. Both stations C' and C^3 are thus supplied with current for exciting their transmitting-telephones, and the clearing-out signal q is also excited while either of the telephones is off its switch-hook. By indicating the replacement of both telephones on their switches the signal gives an automatic call for disconnection. Thus the user of any extension-line may call for and obtain connection with any other extension-line at the branch exchange C , current both for calling and for effecting transmission being derived from the central source h through the medium of the line-wires 3 4. The circuit provided for the supply of current through the main line is free from unnecessary resistance, and the flow of current in the main line is independent of the line-signal b of the line, so that the use of the extension-lines may take place without operating the signal in the central office. The undulating currents produced in the telephone-circuits of the united stations C' and C^3 are prevented from reaching the main line 3 4 by the impedance-coils $l m$ and $l' m'$ and the condenser n .

If the call from branch station C' should be for connection with the main line, the required connection would be established by means of plugs u and u' , the plug u being inserted into the spring-jack t of the trunk-line and the plug u' into the spring-jack i' of line to station C' .

The insertion of plug *u* in spring-jack *t* would break connection between the spring *t*³ and its resting-anvil *t*⁴ and thrust the spring against its outer contact *t*², whereby a direct connection would be formed between conductor 3 of the main line and conductor 9 of the extension-line and between conductor 4 of the main line and conductor 10 of the extension-line. Across this circuit there would be a permanent bridge 17 at the plug-circuit and a controlled bridge through the telephone at the station C'. Current would now flow from battery *h* through the conductor 3, bridge 17, and conductor 4 to earth at the central office, which would excite the line-signal *b* of the main line and call for connection. The call-signal thus displayed would be answered by the attendant in the usual way, and the connection, the order having been given, would be completed by inserting the plugs *d* and *d'* in the spring-jacks *a* of the calling-line and of the line called for, respectively. The insertion of the plug *d* into the spring-jack *a* of the line to station C would effect the disconnection of the normal branches of the line and the battery and would substitute a new connection through the repeating-coil and the plug-circuit, so that the common source of current would still remain connected with the lines for exciting the substation-transmitters and for operating the signals. The continuity of the circuit thus formed through the main line is determined by the presence of the plug *u* in the spring-jack *t*, so that the display of the supervisory signal *f* associated with the plug *d* indicates the withdrawal of the plug from the spring-jack or disconnection of the trunk-line from the calling-line at the branch exchange. The continuity of the circuit through the line to station C' during the connection is, however, controlled both at the substation C' by the telephone-switch there and by the plug *u*. Hence the operator at the branch exchange, observing the supervisory signal *v*, which will be in the path of current to the substation C', may determine when the telephone at the latter station is replaced on its switch at the termination of conversation. If desired, the movement of the supervisory signal *v* indicating the replacement of the telephone on its switch at station C' may be accepted by the operator at the branch exchange as a call for disconnection and may be followed by the removal of plug *u* from spring-jack *t*, whereby the call for disconnection will be made at the central office.

It will be noted that the switching together of the main line and of the extension-line for direct communication does not interfere with the supply of current to other extension-lines which may be in independent communication with one another, the supply-circuit through the extensions of the main line being completed to the conductor 4 of the trunk-line when the ground connection at the branch exchange is broken at the spring-jack

t. By reason of the presence of impedance-coils *l m* and *l' m'* communications may pass independently in the branch-exchange lines and in the main line. It will be further apparent that the telephone at the station C may be used in direct connection with the line in the usual way, as would that of the station A. The station C may also be called by means of the bell in the bridge of the line 3 4 at the station, and required connections may be made from the main line 3 4 to any extension-line, like line to station C', which is furnished with a suitable spring-jack *i'*.

Having thus described our invention, we claim as new and desire to secure by Letters Patent—

1. The combination with a telephone-line extending between a branch exchange and a central office, of a grounded source of current applied to one limb of the line at the central office, a number of extension-lines at the branch exchange connected with the line conductor containing the source of current, a grounded return from the extension-lines to the source of current at the central office, a bridge of the telephone-line circuit at the branch exchange, a telephone in the bridge, a switch for closing said bridge, and an impedance-coil between the extension-lines and the main-line circuit, substantially as set forth.

2. The combination with a metallic-circuit telephone-line extending between a central station and a branch exchange, of a grounded battery connected with one of the line conductors, and a grounded signaling instrument connected with the other line conductor, a telephone at the branch exchange in a bridge of the line-circuit, and a switch controlling said bridge, a number of extension telephone-lines at the branch exchange connected in multiple from the line conductor containing the battery, a ground-return for said extension-lines, and means for connecting said extension-lines in pairs for conversation, substantially as described.

3. The combination with a telephone-line extending in two limbs 3 4 from a branch exchange to a central office, of a source of current-supply for the branch exchange connected at the central office between the limb 3 of the line and earth, a substation-telephone set in a bridge of the line at the branch exchange, a number of extension telephone-lines at the branch exchange connected between the limb 3 and the earth, appliances adapted to prevent the passage of telephone-currents while permitting the passage of direct currents, interposed between said extension-lines and the line conductor 3, line-signals in said extension-lines and switches at the substations of said extension-lines controlling said line-signals, a spring-jack for each of said extension-lines adapted when plugged into to break the normal connection of such line with the conductor 3, a pair of plugs and their plug-circuit for uniting the extension-lines with one

another, said plug-circuit being connected through an impedance-coil with the said line conductor 3, whereby current from the central source is supplied to the united extension-lines through the plug-circuit, and switching apparatus adapted to unite the conductors of the main line with the conductors of an extension-line directly, as described.

4. The combination with a telephone-line, of two line conductors between a central station and a branch exchange, and an earth-return for one of the line conductors, a grounded battery applied to one line conductor and a grounded signal-indicator in the other line conductor in the central station, a bridge between the line conductors at the branch exchange, and means for closing the bridge, an extension-line in a ground branch from the line conductor to which the battery is applied at the branch exchange, a signal in the extension-line at the branch exchange, and a telephone-switch controlling the extension-line for operating the signal; whereby signals may be transmitted independently through the extension-line to the branch exchange and through the main line to the central station, as described.

5. The combination with a main telephone-line having two line conductors between a central station and a branch-exchange station, a grounded source of current applied to one main-line conductor and a grounded signal connected with the other main-line conductor in the central office, means for connecting another line with the said main line and a switch actuated in making such connection to break the normal ground connec-

tions of the line and substitute a source of current in a bridge of the united lines, of extension-lines in normally-grounded branches from the main-line conductor with which the battery is connected, at the branch exchange, a telephone at the branch exchange, and switching mechanism adapted to connect the telephone in a bridge between the conductors of the main line, said switching mechanism being adapted to disconnect the normal grounds of the said extension-lines and to connect the extension-lines in bridges of the main circuit, substantially as described.

6. The combination with a main telephone-line between a central station and a branch exchange, and a source of current connected with the line at the central station, of extension-lines at the branch exchange normally connected with the said main line, through the medium of electrical appliances adapted to impede the passage of undulating currents through them while permitting the passage of unvarying currents, switching apparatus for uniting the extension-lines with one another for conversation, and other switching apparatus for uniting the conductors of the main line with those of an extension-line directly, as described.

In witness whereof we hereunto subscribe our names this 22d day of December, A. D. 1899.

CHARLES E. SCRIBNER.
JAMES L. McQUARRIE.

Witnesses:

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FLORENCE E. SUMMERS.