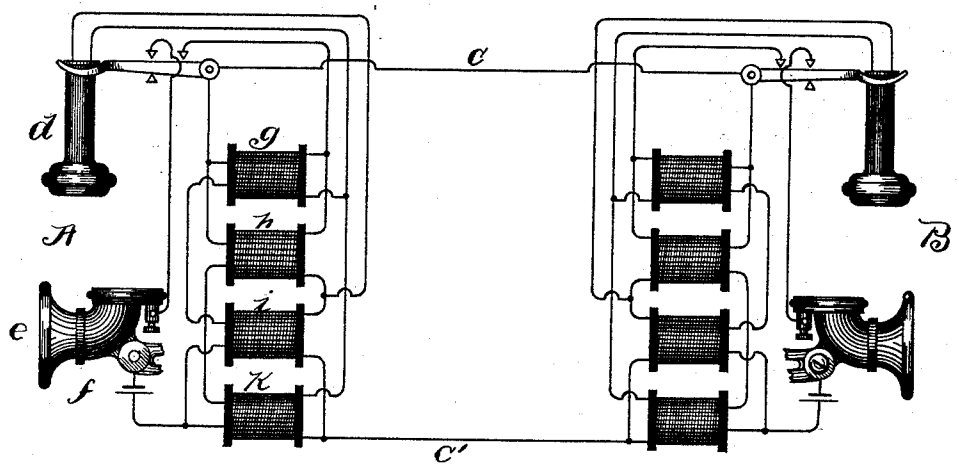
(No Model.)

C. E. SCRIBNER.

TELEPHONE CIRCUIT.

No. 519,876. Patented May 15, 1894.

Fig. 1.



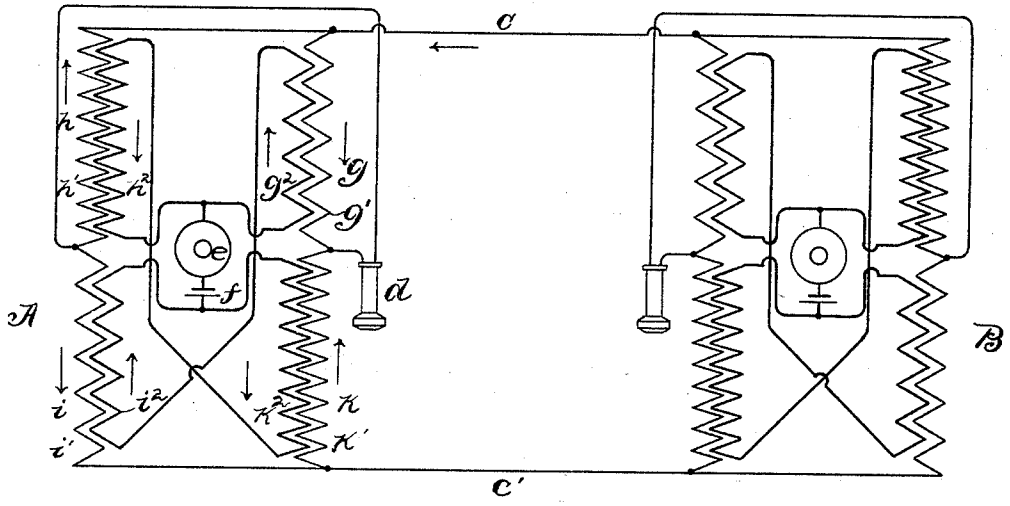


Fig. 2.

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

TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 519,876, dated May 15, 1894.

Application filed September 28, 1893. Serial No. 486,729. (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 Telephone-Circuits, (Case No. 340,) 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 telephonic apparatus and organization of the same in a system. Its object is to provide means for avoiding the reproduction in a telephone receiver of sounds or accidental vibrations in its own microphone, without diminishing the efficiency of telephonic transmission. To this end, I have connected in the circuit with the telephone and microphone, certain accessory induction coils, and have so arranged the circuit connections that during the transmission of outgoing telephonic currents the portions or points of the circuit between which the receiver of the sending station is connected are brought to a condition of no difference of potential; while during the reception of incoming currents, the telephone of the same station is in the path of least resistance to them, and hence transmits and responds to them.

In my previous applications, Serial No. 477,859, filed June 16, 1893, and Serial No. 477,860, filed June 16, 1893, I have described devices having the same purpose and the same general mode of operation. In the former of these prior applications I placed the telephone receiver in shunt of the secondary helix of an auxiliary induction coil whose primary helix was in the microphone circuit, whereby a condition of no potential difference between the telephone terminals during the operation of the microphone was created, the principal novel feature of the invention being, however, the connection of the primary helices of the main and auxiliary induction coils in parallel branches of the microphone circuit by which certain deleterious current reactions were avoided. In the latter application the telephone receiver was connected in series with the secondary helix of an auxiliary induction coil, the secondary helices of the main and auxiliary coils being joined in parallel to the line circuit, whereby a similar null condition was created between the telephone terminals by current in the microphone. In my invention herein, however, I arrange the secondary helices of two induction coils in separate parallel branches of the telephone line circuit, and connect the telephone receiver in a cross connection or bridge between the two parallel branches from points between the two helices in each branch, the microphone being connected with the different primary helices in series-multiple in a manner to avoid the harmful inductive reactions before mentioned. The arrangement is in short a Wheatstone parallelogram in which the telephone line takes the place of the battery circuit, the telephone being connected in the bridge wire, and the secondary helices of the induction coils constituting the sides of the parallelogram. Certain proportains must be observed in the mutual induction of the primary and secondary helices of the induction coils, and in the impedence and resistance of the different secondary helices, which will be hereinafter described in order that the device may be operative. This special proportioning and adjustment among the different parts constitute the essential novelty of my invention.

Two symmetrically placed secondary helices in the parallelogram are constructed to have very high impedence and resistance, while the remaining two secondary helices have comparatively low impedence. A path of comparatively low resistance is thus provided for incoming telephonic currents, through the low impedence helix in one branch, the telephone, and a similar helix in the other branch, the flow of such currents through either branch independent of the telephone being prevented by the high impedence to telephonic currents of the remaining secondary helices in those branches. The inductive relations of the primary and secondary helices of all the coils, respectively, are, however, so adjusted that while telephonic undulatory current is circulating in the microphone circuit, the electromotive forces generated in the secondary helices between the tele-

phone terminals and the same side of the line, balance each other, and thus do not cause nor permit any current to circulate through the telephone, while still acting in parallel to generate current in the line circuit. The electro motive forces induced in these secondary helices during the generation of outgoing telephonic currents thus take the place of resistances in the sides of the parallelogram, in producing a condition of no potential between the terminals of the bridge wire including the telephone.

My invention is illustrated in the accompanying drawings, Figures 1 and 2.

Figs. 1 represents a telephone line extending between two stations, connected at each station with a telephone receiver and four induction coils in accordance with the mode of my invention, and a long distance microphonic transmitter connected in the primary circuit, all the instruments being of well known character. Fig. 2 is a diagram showing the arrangement of circuit connections of the same apparatus.

The stations A and B of the figures are equipped with similar appliances, the apparatus of the two stations being connected together by means of a telephone line $c\,c'$. The apparatus at station A, for example, comprises essentially a telephone receiver d, a microphonic transmitter e, and a battery f for its operation, and four induction coils $g\ h\ i\ k$. The secondary helices g' and k' of coils $g\ k$ are connected in series in one branch between the line wires $c\ c'$; the secondary helices $h'\ i'$ of coils $h\ i$ are similarly connected in another branch between the sides $c\ c'$ of the circuit, in parallel with the first. The telephone receiver d is included in a branch or bridge wire which unites the two parallel branches from points between the helices g' and k' and h' and i', respectively. The primary helices $g^2\ i^2$ of coils $g\ i$ are connected in series in a conductor, and the primary helices $h^2\ k^2$ are similarly connected in another conductor, the two conductors forming parallel branches of the circuit or microphone e. The secondary helices $h'\ k'$ are constructed to have high resistance and impedence or self-induction to the rapidly alternating incoming telephonic currents; while helices $g'\ i'$ are constructed to be of low impedence. The required high impedence may be obtained in any well known way, as by winding the helices with many turns, or by surrounding them with iron in a closed magnetic circuit. The helices $h'\ k'$ are represented as being of large numbers of turns. The inductive influences of the primary helices $i^2\ k^2$ upon their respective secondary helices $i'\ k'$ are adjusted to create in the secondary helices electromotive forces equal to each other, or which have the same ratio to the electromotive forces in the coils h' and g', respectively. Under such conditions of balanced electromotive forces, obviously no difference of potential will exist between the terminals of the telephone d, and it will not be affected by the telephonic current generated in the different induction coils. It is preferable that the electromotive forces in the helices i' and k' and g' and h' should be equal, respectively, since otherwise some of the generated or outgoing current will be shunted through the branch in whose included secondary helices the lower aggregate electromotive force exists. No means of adjusting the electromotive force induced in the different secondary helices are shown in the drawings, many ways of doing this being known to those familiar with the art to which this invention pertains. Thus the primary helix may be shunted or increased in resistance to decrease the current in it, or it may be removed to a greater distance from its secondary helix, or the magnetic character of its surrounding may be altered.

The primary helices $g^2\ h^2\ i^2\ k^2$ are connected in the microphone circuit in a manner to induce electromotive forces in their respective secondary helices in the same general direction in the circuits, the helices in each branch thus acting in series and the two branches co-operating in parallel to send outgoing current to line. The primary helices are connected together in multiple series, each branch of the microphone circuit containing the primary helix of a coil in each branch of the line circuit. It results from this mode of connection that current induced in the primary helices of the low resistance secondary helices, which carry the incoming telephonic currents, by such incoming currents, will circulate through the other primary helix in the same branch of the microphone circuit in a direction to oppose the passage of the incoming current through the high resistance helix, thus increasing the effective resistance of the latter, and directing a greater part of the incoming current through the telephone.

When, in the operation of the system, varying current, rendered characteristically undulating by the microphone e, traverses the microphone circuit and the primary helices $g^2\ h^2\ i^2\ k^2$ connected therewith, these helices induce in their respective secondary helices electromotive forces which, acting together, create "outgoing" telephonic current in the line circuit. During such operation the generated electromotive forces of the secondary helices are so balanced, as described, that no potential difference exists between the terminals of receiver d; hence no current traverses it, and it remains silent. When, however, the instruments are in use in receiving incoming currents from the distant station, as B, the current takes a path including the telephone, viz. from line c through the helix g' of low resistance and retardation, thence through the telephone d, and thence to line c' through the other low resistance helix i'. At

the same time some current is induced in the primary helices g^2 i^2 which circulates through helices h^2 k^2 in the directions indicated by arrows in the drawings, and acts to produce electromotive forces in helices h' k', assisting their resistance and impedence in opposing the passage of the incoming current through them. Thus I am enabled to avoid the "side tone" or noise produced in the receiver by the operation of its own microphone, without diminishing the efficiency of the telephonic system for either receiving or transmitting articulate speech. Indeed, this efficiency is somewhat increased by the removal of the resistance of the telephone from the circuit. It will be noted that the operation of my invention herein is independent of the line resistance, no resistance or portion of a circuit essential to the perfect operation of the device being external to the appliances at the station.

It is obvious that my invention is not limited to its application in connection with telephone apparatus for the prevention of side tones in the receiving telephone; its broad novelty consists in the provision of electromotive forces in the different branches of the parallelogram in place of the inert resistance of the ordinary Wheatstone bridge arrangement, the electromotive forces being proportioned or capable of adjustment among themselves to produce the desired condition of no potential difference between the terminals of the telephone. I believe it to be further new to make two symmetrically disposed sides of such a parallelogram having sources of electromotive force in its sides, of high resistance, so as to direct incoming currents through the bridge wire. The operation of the system in its broad application would, however, be the same as described herein in connection with telephone appliances.

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

1. The combination in a Wheatstone parallelogram, of sources of electromotive force in the four sides thereof, a bridge wire containing an instrument responsive to electric currents connected between two opposite angles of the parallelogram, and an electric circuit containing other instruments responsive to electric currents connected with the remaining angles of the parallelogram, the said sources of electromotive force being adjustable with respect to each other to produce a condition of no difference of potential between the terminals of the said bridge wire, substantially as described.

2. The combination in an electric circuit including an instrument sensitive to electric current, said circuit being divided at one point into two parallel branches, of two sources of electromotive force in each branch, and a bridge wire connecting two branches from points between sources of electromotive force in each, the different sources of electromotive force being adjustable with respect to each other to produce a condition of no difference of potential between the terminals of the bridge wire; and one portion of each branch between the bridge wire and different sides of the circuit being constructed to have high resistance to incoming currents in the circuit, whereby the incoming currents are directed through the receiving instrument in the bridge wire, while outgoing currents generated by the said sources of electromotive force do not send any current through said bridge wire, substantially as described.

3. The combination in a telephone circuit divided into two parallel branches, of a bridge wire including a telephone receiver uniting the two parallel branches, and sources of telephonic current, two in each branch, upon opposite sides of the connection of the said bridge wire with that branch, the said sources of current having their electromotive forces adjusted to produce a condition of no difference of potential between the terminals of the bridge wire, whereby outgoing telephonic current is transmitted to the line without traversing the telephone receiver, as described.

4. The combination in a telephone circuit divided into two parallel branches, of a bridge wire containing a telephone receiver uniting the two branches, two sources of telephonic current in each branch, one upon each side of the point of connection of the bridge wire with the same branch, one portion of each branch, upon opposite sides of said bridge connection, being constructed to have high impedence, and the electromotive forces of the different sources of current being adjustable to produce a condition of no difference of potential between the terminals of the said bridge connection, whereby outgoing telephonic currents are generated without affecting the telephone receiver, while incoming currents may be directed through the said receiver, substantially as described.

5. The combination with a telephone line, of four induction coils having their secondary helices connected in two parallel branches of the telephone circuit, two in each branch, and their primary helices in circuit with a common microphone, a telephone receiver having one terminal connected to each branch between the two induction coils thereof, one secondary helix in each branch, upon opposite sides of the telephone terminals, being constructed to have high impedence, as described.

6. The combination in a telephone circuit, of four induction coils having their secondary helices connected in two parallel branches of the telephone circuit, two in each branch, a telephone receiver connected between the different branches from points intermediate of the two helices therein, the primary helices being connected in multiple series with a microphone, the primary helix of a coil in one

branch being included in series with the primary helix of a coil in the other branch upon the opposite side of the telephone connection, whereby incoming telephonic currents are directed through the telephone receiver by the reaction of the currents induced in the primary helices thereby, substantially as described.

In witness whereof I hereunto subscribe my name this 19th day of July, A. D. 1893.

CHARLES E. SCRIBNER.

Witnesses:
CHARLES A. BROWN,
GEORGE L. CRAGG.