(No Model.)

C. E. SCRIBNER.

TELEPHONE CIRCUIT.

No. 552,730. Patented Jan. 7, 1896.

Fig. 1

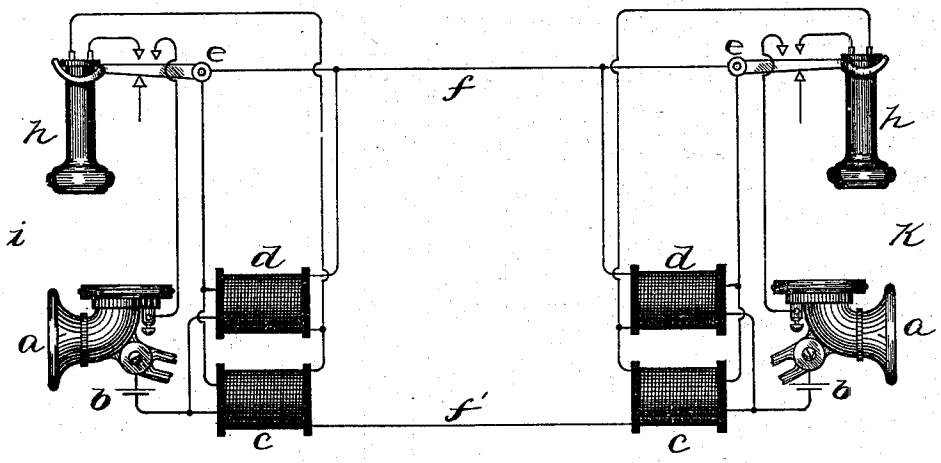
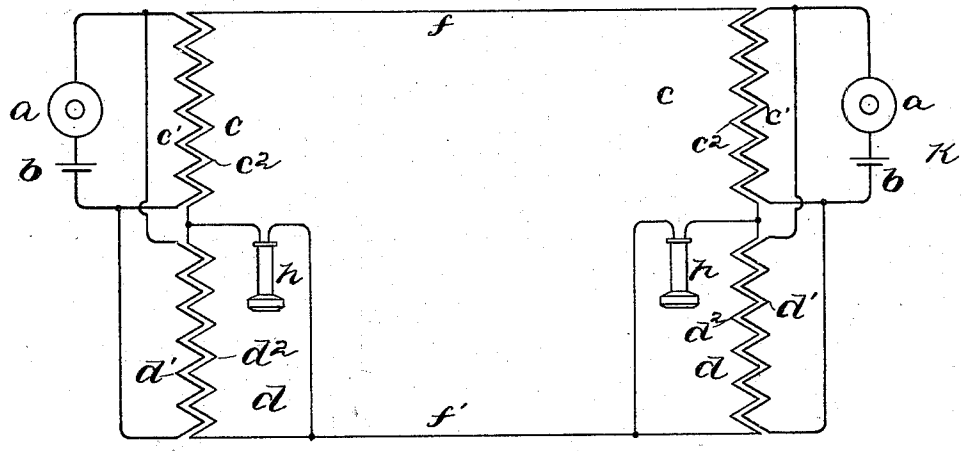


Fig. 2.



WITNESSES:
George L. Cragg
George S. Brull

INVENTOR:
Charles E. Scribner.
By Parton & Brown
Attorneys.

UNITED STATES PATENT OFFICE.

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

TELEPHONE-CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 552,730, dated January 7, 1896.

Application filed June 16, 1893. Serial No. 477,859. (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. 336,) 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.

As is well known in the art of telephony, the telephone-receiver at a station is included in circuit with the secondary helix of an induction-coil whose primary helix is in the circuit of the microphone at the same station, so that disturbances or vibrations of the microphone are reproduced in its own telephone-receiver, such sounds being ordinarily designated "side tones." The side tones may be either noises arising from accidental vibration or jarring of the microphone or the vocal sounds spoken by the user of the microphone. The noises produced by the jarring of a powerful transmitter are frequently sufficiently loud to mask or obscure the articulate sounds reproduced in the receiver when it is in use, while the sounds reproduced in the receiver during the use of the corresponding microphone are so loud as to make the close application of the telephone to the ear unpleasant or injurious, while if the receiver be momentarily removed to avoid the loud sound the reply from the distant station may be lost.

It is the object of my invention to avoid such side tones in telephone-receivers. This aim is attained by an arrangement and organization of the microphone and telephone in connection with two induction-coils such that only a slight difference of potential is produced between the points of the circuit with which the telephone is connected by outgoing undulatory currents in the microphone-circuit, while with respect to incoming currents the difference of potential between the points to which the telephone is connected is quite considerable.

More specifically, I provide in my invention two induction-coils whose primary helices are connected with the same microphone and whose secondary helices are connected in series in the line-circuit; and I connect the telephone-receiver in shunt or parallel circuit with the secondary helix of one of the induction-coils. The connections of the primary helix with the microphone-circuit are so made that the pulsations of current induced by them in their respective secondary helices are in the same direction in the line-circuit and the mutual induction of the respective primary and secondary helices is so adjusted that the electromotive forces in the two secondary helices create a condition of little or no difference of potential between the terminals of the telephone-receiver during the transmission of outgoing telephonic currents, the secondary helix, which is in parallel with the receiver, being at the same time made of as high self-induction as practicable in order to reduce to a minimum its shunting effect upon the receiver for incoming telephonic currents.

In my invention I connect the primary helices of two induction-coils in separate parallel branches of the microphone-circuit, in order to avoid the injurious reaction of the secondary helices upon each other through the medium of their united primary helices in the receiving of incoming telephonic currents. If the primary helices were connected in series, the current induced in the primary helix of the main induction-coil by incoming current in its secondary helix would be in such direction through the other primary helix as to reduce the impedance or opposition of the secondary helix in parallel circuit with the receiving-instrument, tending to produce a condition of no difference of potential between the terminals of the receiver; but by employing the mode of connection I have devised in my invention the current induced in the primary helix of the main induction-coil is in proper direction through the other primary helix to cause increased opposition to the passage of the incoming currents through the secondary helix in shunt of the telephone, thus increasing the efficiency of the system.

My invention is illustrated in the accompanying drawings, and may be more fully described with reference thereto.

In the drawings, Figure 1 represents two stations, each equipped with a long-distance

transmitter, a telephone-receiver and two induction-coils in accordance with my invention, the apparatus represented being of well-known design. Fig. 2 is a diagram illustrating the circuit connections of the instruments shown in Fig. 1.

The microphone a is included in a local circuit with the battery b and with the primary helices c' and d' of two induction-coils c and d, the primary helices being placed in parallel branches of the local circuit.

As seen in Fig. 1, the microphone-circuit is connected with the contact-points of a telephone-switch e by which it is closed when the telephone is removed from the switch-hook, in the usual way. The secondary helices c^2 and d^2 of the induction-coils c and d are connected in series in the line-circuit $f\,f'$. The telephone-receiver h is placed in a branch of the line-circuit in parallel with the secondary helix d^2. The connections of the primary circuits with the local circuit are so made that undulatory currents through the primary helices c' d' induce currents in their respective secondary helices c^2 d^2 in the same direction in the line-circuit, as indicated by the arrows in Fig. 2.

It is well known in the art that in a circuit containing two sources of electromotive force the electromotive force of one of the sources may be so adjusted that no difference of potential will exist between its terminals. I take advantage of this principle by so adjusting the mutual inductions between the primary and secondary helices of the respective induction-coils c and d that with a given resistance in the line $f\,f'$ no difference of potential exists between the terminals of the secondary helix d^2 while undulatory current is circulating in the primary circuit. Under this condition no current will flow through the telephone-receiver h, and hence no side tone will be produced therein. The coil d^2 thus produces no useful current in the line-circuit, but contributes only sufficient electromotive force to overcome its own resistance, thus permitting the helix c^2 of the induction-coil c to impress its full electromotive force upon the line-circuit $f\,f'$, creating current through the instruments at the distant or receiving station. The secondary helix d^2 is constructed to be of high impedance, preferably by making it of many turns of fine wire and placing in its field a considerable mass of iron, the effect of the high impedance being to prevent any considerable portion of the rapidly-changing telephonic currents flowing from a distant station through the line-circuit $f\,f'$ from being shunted from the telephone-receiver h through the helix d^2. Obviously, whatever the impedance of the coil d^2 may be, and however obtained, the electromotive force induced in it by its primary d' may be brought to the requisite value by properly adjusting either the mutual induction between the helices d' d^2 in any well-known manner, as by a suitable proportioning of the number of turns in the coil d', or by adjusting the current strength in the primary d' by means of non-inductive resistance in circuit with it.

The terminal stations, as i k, of the telephone-line $f\,f'$ are equipped with similar apparatus. When sounds are made in the transmitter a at station i, the undulating current set up in the primary circuit causes induced currents in the secondary helices c^2 and d^2. The coil c^2 sets up in the line-circuit $f\,f'$ a corresponding alternating telephonic current. This current traverses the helix d^2 unimpeded by its resistance and self-induction and finds circuit to station k. No portion of the telephonic current traverses the receiver h at station i, since there exists no difference of potential between the terminals of the helix d^2 with which the telephone-receiver is connected. At the station k the telephonic current finds circuit through the secondary helix c^2 and thence through the telephone-receiver h to the other side of the line-circuit. The rapidly-alternating currents are prevented from passing through the secondary helix d^2 on account of the high impedance of the latter. It will be observed that in this arrangement not only does the coil d^2 not impede the telephonic current from the helix c^2, but the telephone-receiver h itself is not, in effect, in circuit with its own induction-coil, since the telephonic current is not compelled to traverse its magnet-coil.

The advantage of connecting the helices c' d' of the induction-coils in parallel circuit, in accordance with my invention, is as follows: Telephonic currents from the distant station finding circuit through the helix c^2 induce a current in the helix c', which largely finds circuit through the low-resistance microphone-circuit; but a portion of the induced current finds circuit through the other primary helix d', thus impressing upon the secondary helix d^2 an electromotive force, which, however, is of such direction as to oppose the passage of the telephonic current from line through it. When the helices c' d' are connected in series, such induced current in the primary circuit circulates through both primary helices, inducing current in the secondary helix d^2 in such direction as to assist the passage of the telephonic currents through the helix, and tending to reduce the difference of potential between the terminals of the telephone-receiver.

I am thus enabled to organize a telephone system in which no sound is produced in a telephone-receiver by the operation of its own microphone, while at the same time the sound-vibrations of the microphone are reproduced in the distant telephone-receiver with the greatest efficiency.

My invention is obviously of broader scope than as applied in connection with telephone apparatus. It may be utilized in any case in which it is desirable to have a receiving or responsive instrument in circuit with a source of alternating current by which the respon-

sive instrument should not be operated, the responsive instrument being placed in the position of the telephone-receiver which I have described, and an additional source of alternating current of suitable electromotive force being included in parallel with the responsive instrument.

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

1. In combination, two helices adapted to have electromotive forces induced in them, connected in series in the same circuit, and a receiving instrument adapted to respond to varying currents in parallel circuit with one of the secondary helices, said second mentioned helix being adjusted so that no difference of potential exists between the points from which the receiving instrument is branched, substantially as described.

2. The combination with a source of variable magnetic field, of two helices in the said field connected in series in the same electric circuit, a responsive device for electric currents connected in parallel circuit with one of the said helices, and a source of electric current in circuit with the two helices adapted to operate said responsive device, the points of the line circuit with which the responsive device is connected being adjusted to a condition of no difference of potential with respect to outgoing currents by the adjustment of the electromotive force of the helix connected between the said points, substantially as set forth.

3. The combination with two induction coils having their primary helices in circuit with a source of varying current and their secondary helices in series in an electric circuit, of a responsive device connected in parallel with one of the said secondary helices, and a source of electric current in the said electric circuit adapted to actuate or control the said responsive device, the electromotive force in the secondary helix in parallel with the responsive device being adjusted to produce a condition of no difference of potential between the terminals of the responsive device with respect to outgoing currents, substantially as and for the purpose described.

4. In combination, a microphone included in a local battery circuit, two induction coils having their primary helices connected in circuit with the microphone, and their secondary helices in series in a telephone line, and a telephone receiver in shunt or parallel circuit with one of the secondary helices, substantially as described.

5. In combination, two induction coils having their primary helices in circuit with the same microphone, and their secondary helices in series in a telephone line circuit, and a telephone receiver in parallel circuit with one of the secondary helices, the said helix in parallel circuit with the telephone being adjusted to have an electromotive force such in direction and amount as to produce points of no difference of potential between the telephone terminals, whereby the side tone is avoided, substantially as described.

6. The combination in a telephone system, of a microphone at each station including in its circuit the primary helices of two induction coils whose secondary helices are included in series in the telephone circuit, and a telephone receiver connected in parallel circuit with one secondary helix at each station, the secondary helices in the parallel circuit with the telephones being constructed to have high impedance and to have electromotive forces induced in them such in direction and amount as to produce points of no difference of potential between the telephone terminals, whereby the side tone is avoided and the telephone receiver at either station is made responsive only to telephonic currents produced at the other station.

7. The combination with a microphone, of two induction coils having their primary helices in parallel branches of the microphone circuit and their secondary helices in series in a telephone circuit, and a telephone receiver in parallel circuit with one of the secondary helices, the secondary helix in parallel with the telephone being adapted to have an electromotive force induced in it sufficient to produce points of no difference of potential at the terminals and the telephone, substantially in the manner described.

8. In combination, two induction coils having their secondary helices connected with a circuit containing a source of variable currents, and their primary helices connected in parallel branches of a circuit, the circuit connections being arranged so that current induced in one of the primary helices by incoming current in its secondary helix increases the opposition of the other secondary helix to said incoming current.

In witness whereof I hereunto subscribe my name this 5th day of May, A. D. 1893.

CHARLES E. SCRIBNER.

Witnesses:
ELLA EDLER,
LUCILE RUSSELL.