No. 715,999. Patented Dec. 16, 1902.

W. M. DAVIS.

TELEPHONE SYSTEM.

(Application filed June 17, 1901.)

(No Model.)

Fig. 1.

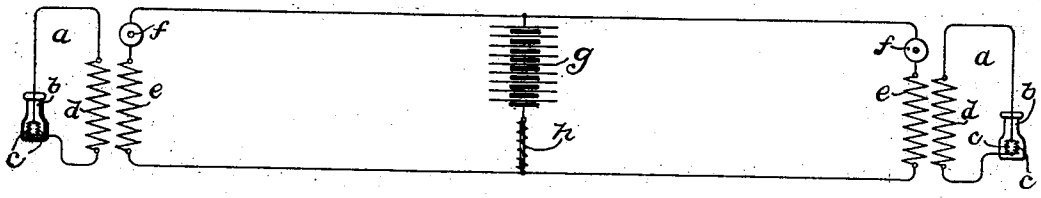


Fig. 2.

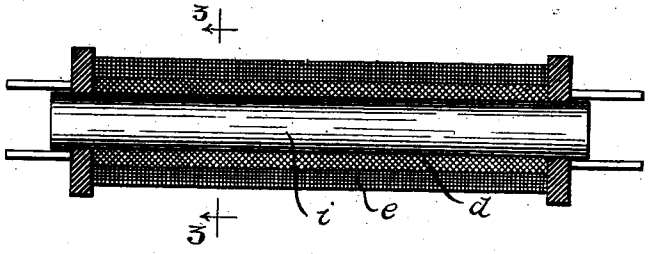
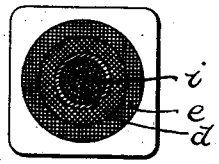


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM M. DAVIS, OF CHICAGO, ILLINOIS, ASSIGNOR TO STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 715,999, dated December 16, 1902.

Application filed June 17, 1901. Serial No. 64,854. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. DAVIS, 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 Systems, 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 telephony, and has for its object the provision of improved circuit arrangements for telephone systems employing primary and secondary windings of transformers.

The invention relates particularly to that class of telephone systems wherein the receiver is included in a local secondary circuit with the secondary winding. In practicing this form of telephony the primary winding has usually been included directly in the main line, as also the transmitter, battery-current having been usually supplied to the transmitter and the primary winding over the telephone-line. The primary winding has usually been of one-half-ohm resistance, while the receiver contained resistance to the amount of ninety ohms and the secondary winding to the extent of sixty ohms, the secondary circuit having thus vastly more ohmic resistance than the primary winding. In practicing my invention I increase the primary winding preferably to eleven ohms, which causes additional impedance in the circuit including the same.

It is the object of my invention to counteract or nullify the impedance due to the primary winding, which I accomplish by means of a low-resistance secondary circuit. This secondary circuit includes a secondary winding, which instead of being of high resistance—as, for example, sixty ohms, according to the prior art—is greatly reduced, having, preferably, ten and one-half ohms. In order to maintain this secondary circuit of as low resistance as possible, the receiver included therein is provided with two coils, each of fifty ohms, connected in parallel in the circuit. The secondary circuit thus in practice has about thirty-five-and-one-half-ohms resistance. This secondary circuit by being of this low resistance, which is about one-fourth of resistance usually employed in the prior art, serves to counteract impedance due to the primary winding. In order to get the necessary strength of current and pressure in the secondary circuit that would otherwise be impaired by the reduced number of turns and resistance in the secondary winding, the primary winding has its resistance and number of turns increased to maintain or produce the required transformation. Thus are two important departures made from the practice of the prior art—one the reduction of the resistance in the secondary circuit, particularly the secondary winding therein, and the other an increase over accepted practice in the length of wire and number of turns in the primary winding.

It is well known that a closed secondary circuit of high resistance will not serve to reduce the impedance due to a coil in inductive relation therewith. It is essential to have a secondary circuit or closed local circuit of very low resistance. If it is sought to reduce the resistance in the secondary circuit by reducing the resistance of the secondary winding, a difficulty is met in that with the arrangement of the prior art the required strength of transformation between the primary and secondary windings is not retained. Therefore after having reduced the resistance of the secondary winding in accordance with a preferred method of practicing my invention the primary winding is increased, so as to compensate for the reduced number of turns in the secondary winding.

I will explain my invention more fully by reference to the accompanying drawings, illustrating the preferred embodiment thereof, in which—

Figure 1 illustrates the application of the invention to a common battery system. Fig. 2 is a longitudinal sectional elevation of a transformer entering into the preferred embodiment of the invention. Fig. 3 is a sectional view on line 3 3 of Fig. 2.

Like parts are indicated by similar charac-

ters of reference throughout the different figures.

I have omitted from the diagram all switching appliances, merely illustrating the electrical condition of a circuit existing between two subscribers that may be connected in well-known ways by well-known apparatus at a central exchange.

I have indicated diagrammatically one type of telephone system, but other telephone systems may have my invention applied thereto.

In practicing my invention the resistance of the secondary circuit *a*, including the receiver *b*, is reduced at the receiver by including two coils *c c*, each preferably of fifty-ohms resistance, in parallel in the circuit, the receiver thus presenting a resistance of twenty-five ohms instead of the higher resistance of ninety ohms or so with the arrangement of the prior art. To further reduce the resistance of this secondary circuit, the secondary winding *d* has its resistance about one-fifth that which it was necessary to employ in the prior art, being, preferably, ten and one-half ohms. The secondary circuit thus organized creates sufficient electromotive force to overcome or reduce the impedance due to the primary winding. This secondary circuit thus greatly reduced in resistance, while sufficient to overcome the impedance due to the primary winding, is not well adapted with the form of primary winding employed in the prior art to provide the necessary strength of transformation to secure effective operation of the receiver. I prefer to secure the required current conditions in the secondary circuit by increasing the number of turns in the primary winding *e* and the resistance thereof, by which arrangement the required secondary of low resistance is obtained without impairing the current conditions of the secondary circuit, while at the same time removing the impedance. As a result I am enabled to secure a transmission of voice-currents that is far superior to results that have heretofore been secured, the receivers in the secondary circuits being rendered thereby much more sensitive to the voice-currents, which have full effect thereupon because of the removal of the impedance. A battery-transmitter *f* is included at the same substation with the corresponding winding *e*. Two substations are illustrated, a common battery *g* being connected in multiple between the lines, impedance *h* being included in the same bridge with the battery. The induction-windings are preferably wound about a core *i*, one coil being superposed upon and inclosing the other. As the primary winding in accordance with the preferred practice of my invention tends to create greater impedance, this winding is preferably the one that is superposed, being thereby further removed from the core to reduce the reactance. The secondary winding, conversely, should have its reactance increased to counteract the impedance due to the primary winding, and on this account it is placed next to the core. I have secured good results in practice by providing eight layers of No. 26 Brown & Sharpe gage wire for the secondary winding, having ten-and-one-half-ohms resistance and having two thousand five hundred and forty turns. The primary winding may have six layers of No. 26 Brown & Sharpe gage, having a resistance of eleven ohms and having one thousand nine hundred turns. The receivers *b* are thus subject to the full fluctuating voice-currents by reason of the absence of the counteracting impedance.

The main difference between my present invention and the prior art consists in the provision of a secondary receiver-circuit that is of such a character as to overcome the impedance due to the primary winding, which result was not secured hitherto because of the very high resistance of the secondary circuit. As an additional difference between my present invention and the prior art there is the provision of the primary winding, that is adapted to compensate for the reduced resistance of the secondary winding to maintain and improve the necessary electrical condition in the secondary circuit.

I believe it to be broadly new with me to provide the combination, with a telephone receiver and transmitter, of primary and secondary windings having substantially the same resistance.

By means of my invention I have secured far superior results to those that have been obtained in commercial practice hitherto, and while I have particularly described the preferred embodiment of the invention I do not wish to be limited thereto, as modifications may be made without departing from the spirit thereof; but,

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

1. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit of low resistance including the secondary winding and a telephone-receiver, substantially as described.

2. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, substantially as described.

3. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, substantially as described.

4. In a telephone system, the combination

with the primary winding of comparatively high resistance of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, substantially as described.

5. In a telephone system, the combination with the primary winding of comparatively high resistance of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, substantially as described.

6. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit of low resistance including the secondary winding and a telephone-receiver, the primary and secondary windings being of substantially the same resistance, substantially as described.

7. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the primary and secondary windings being of substantially the same resistance, substantially as described.

8. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a seconday circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the second circuit, the primary and secondary windings being of substantially the same resistance, substantially as described.

9. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary and secondary windings being of substantially the same resistance, substantially as described.

10. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a secondary winding and a telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary and secondary windings being of substantially the same resistance, substantially as described.

11. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit of low resistance including the secondary winding and a telephone-receiver, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

12. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

13. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

14. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

15. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a secondary winding and a telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

16. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a trans-

mitter and battery in circuit therewith, and a secondary circuit of low resistance including the secondary winding and a telephone-receiver, the primary and secondary windings being of substantially the same resistance, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

17. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the primary and secondary windings being of substantially the same resistance, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

18. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a low-resistance secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary and secondary windings being of substantially the same resistance, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

19. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a secondary winding and a low-resistance telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary and secondary windings being of substantially the same resistance, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

20. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including a secondary winding and a telephone-receiver, the receiver having two coils connected in parallel and included in the secondary circuit, the primary and secondary windings being of substantially the same resistance, the primary winding being superposed upon the secondary winding and surrounding the same, these windings being placed about a common magnetic core, substantially as described.

21. In a telephone system, the combination with the primary winding of an induction-coil included in a telephonic circuit, of a transmitter and battery in circuit therewith, and a secondary circuit including the secondary winding and a telephone-receiver and serving to create counter electromotive force to overcome impedance due to the primary winding, substantially as described.

22. The combination with the primary winding of an induction-coil or transformer, of a battery and transmitter in closed circuit therewith, a secondary winding and a receiver in closed circuit therewith, the said primary and secondary windings approximating equality of resistance, substantially as described.

23. The combination with a primary winding, of a battery and a transmitter in closed circuit therewith, of a secondary winding and a receiver in closed circuit therewith, the said primary and secondary windings being of substantially the same resistance, the primary winding being superposed upon and inclosing the secondary winding, both of the windings being located upon a common core, substantially as described.

24. The combination with the primary winding of an induction-coil or transformer of a battery and transmitter in closed circuit therewith, a secondary winding and a receiver in closed circuit therewith, the said primary and secondary windings being respectively and compared with prior telephone induction-coils of high and low resistance and approximating the same resistance, substantially as described.

In witness whereof I hereunto subscribe my name this 23d day of May, A. D. 1901.

WILLIAM M. DAVIS.

Witnesses:
GEORGE L. CRAGG,
HERBERT F. OBERGFELL.