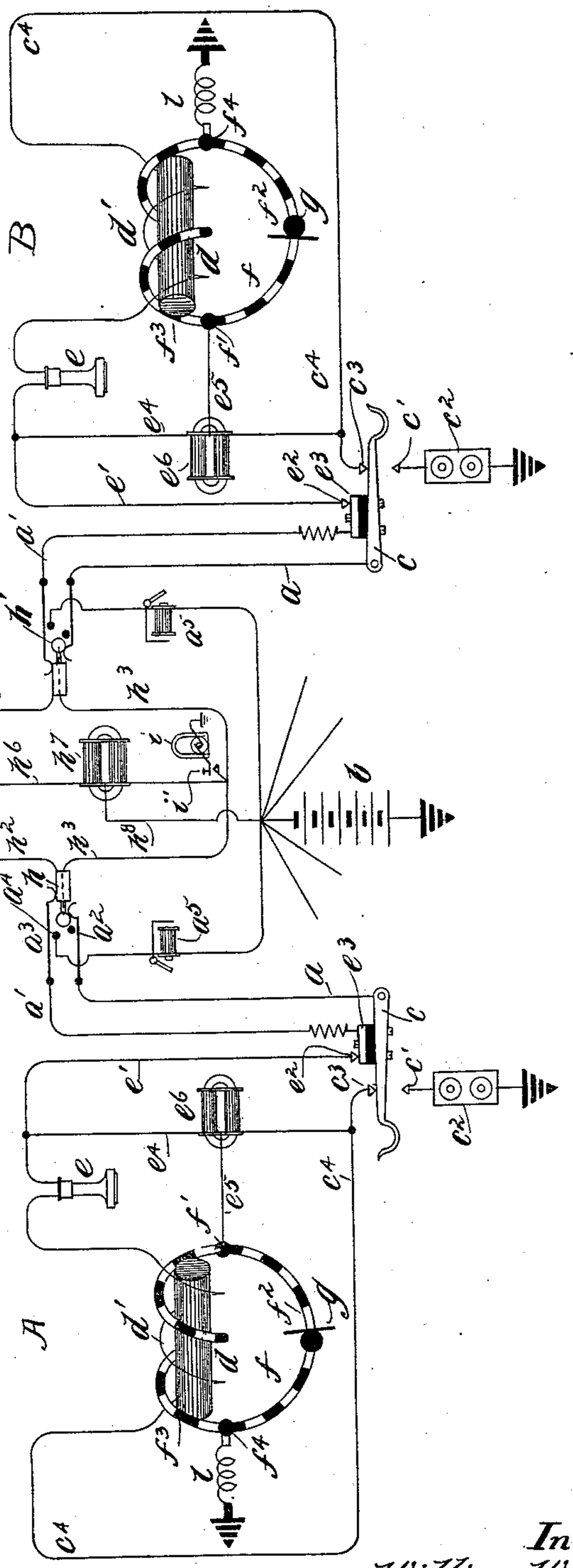
(No Model.) 2 Sheets—Sheet 1.

W. W. DEAN.

TELEPHONE SYSTEM.

No. 541,077. Patented June 18, 1895.

Fig. 1.



Witnesses:
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(No Model.) 2 Sheets—Sheet 2.

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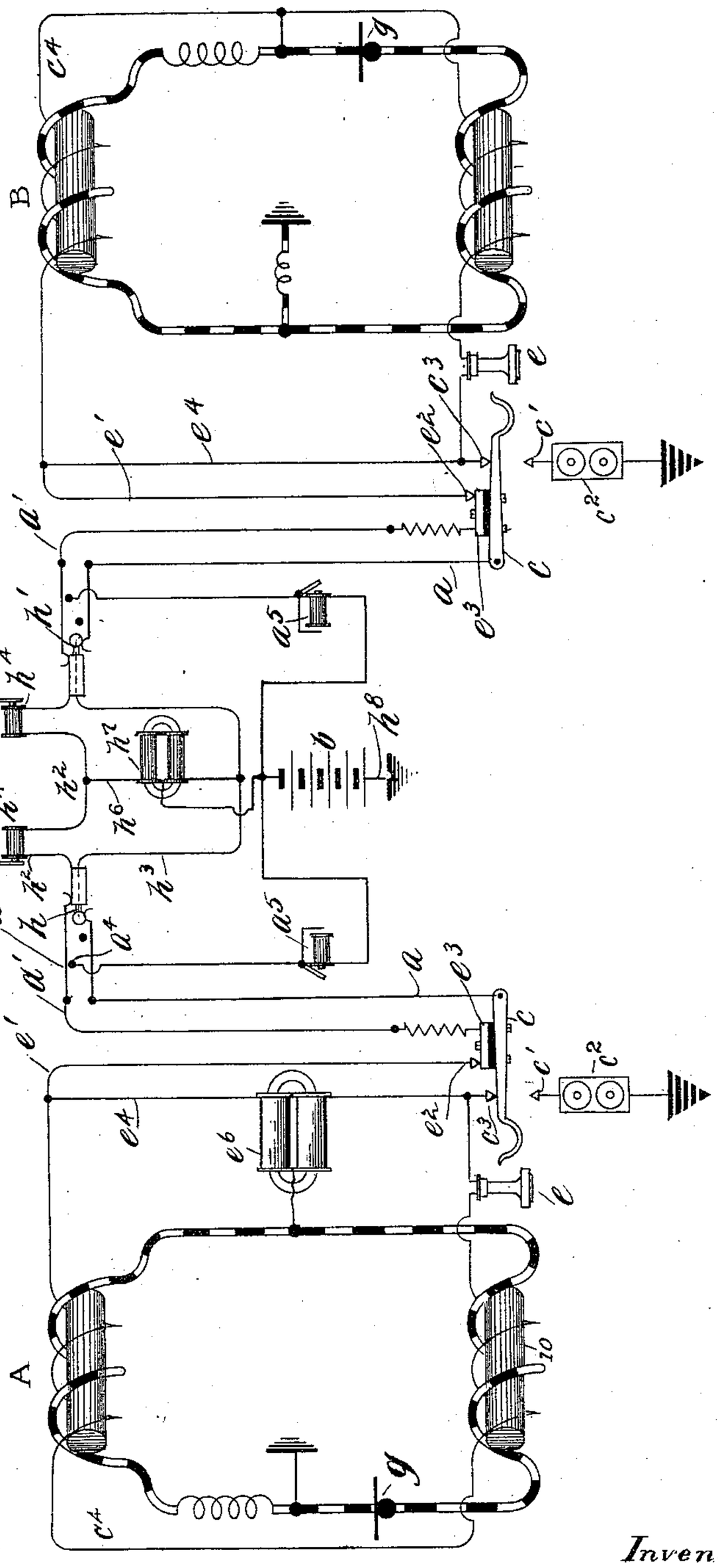
Fig II



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UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF ST. LOUIS, MISSOURI, ASSIGNOR TO THE BELL TELEPHONE COMPANY OF MISSOURI, OF SAME PLACE.

TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 541,077, dated June 18, 1895.

Application filed February 21, 1895. Serial No. 539,209. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Telephone Systems, (Case No. 1,) 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 a telephone system, and its object is to dispense with the employment of local batteries at the subscribers' stations for supplying the current to the transmitting instruments and to provide means whereby a single battery at the central station, or in other centralized position, may be employed for supplying the current to all of the subscribers' transmitters.

Heretofore it has been impossible to obtain a high efficiency by supplying the subscribers' transmitters from a battery at the central station. It has therefore been the practice to provide at each subscriber's station a local circuit containing a battery, the subscriber's transmitter and the primary of an induction coil, the secondary of which is included in the telephone line. By this arrangement an efficient operation of the transmitter or microphone is obtained, but it necessitates the placing of a battery at each of the subscribers' stations. The increased efficiency in the operation of the transmitter when local circuits are employed may be illustrated by supposing that a telephone line having a resistance of say one thousand ohms is included directly in circuit with a microphone and a battery. If the microphone is capable of producing a change in resistance of one ohm it will appear that the current traversing the circuit will be changed by one one-thousandth of its value. If on the other hand the microphone and battery be included in a local circuit having a resistance, say, of twenty ohms, and be connected with an induction coil and the telephone line, a change of one ohm resistance by means of the microphone will produce a change in the strength of the battery current of one-twentieth of its value.

The object of the present invention is to secure the advantages arising from the employment of a local circuit containing a local battery, while at the same time dispensing with the employment of the local batteries, and substituting therefor a single battery at the central station or other central point.

The employment of local batteries is a disadvantage in that considerable labor is necessary in keeping them in repair and renewing them from time to time; and further as they are in actual use during only a small fraction of the day, the capital represented by the cost of the batteries is idle during the greater portion of the time. By the employment of a single battery for all or a large group of the lines not only is there a considerable reduction in the first cost of equipment, but the battery is in almost constant use.

In accordance with my invention, I provide at the central station a battery adapted to supply current to all or a group of the telephone lines, and provide at each subscriber's station a local or transmitter circuit comprising at least two branches, containing the microphone and the primary of an induction coil.

Considering the form in which the microphone is included in one branch of the local transmitter circuit and the primary of the induction coil in the other branch, the advantage over the employment of the microphone in circuit alone with the battery will be readily understood. Thus using the former illustration, if the telephone line has a resistance of one thousand ohms and the microphone is capable of producing a change in resistance of one ohm, the current flowing will be changed by one one-thousandth of its value, whereas, by my invention, supposing that the branch containing the microphone has a resistance of twenty ohms, while the branch containing the induction coil has a resistance of twenty ohms also, the same amount of current will flow through each branch. If now the microphone be operated to produce a change of resistance of one ohm in its branch so that the resistance of the microphone branch will be twenty-one ohms while the resistance of the induction coil branch remains at twenty ohms, twenty-one forty-firsts of the current will flow through the induction coil branch, whereas but a half previously flowed through the same, the current through the induction coil being

thus increased by one eighty-second of its value instead of by one one-thousandth as in the former instance. Furthermore, the change of current in the local or transmitter circuit depends primarily on the resistance of the local circuit and is practically independent of the length or resistance of the telephone line or whatever wire may be utilized as the feeding circuit, possessing in this respect the advantages of the local circuit containing a local battery as heretofore employed.

In the preferred form of my invention, I connect the battery at the central station with the cord sets of the operators so that normally the subscribers' transmitters are not in circuit with the battery, but the battery is included in circuit when the operator inserts one of the plugs of her set into the spring jack of the subscriber's line. The telephone line which I usually employ has two metallic limbs which extend to the central station and terminate in contact points adapted to be connected with the strands of the operator's cord set, the battery being included in a ground branch which is connected with both of the strands of the cord set. At the subscriber's station the two limbs are united during conversation and connected at one point to the local or closed circuit containing the microphone and the induction coil while the closed circuit is connected at another point to ground. During conversation the circuit of the battery is thus closed through the two metallic limbs of the telephone line in multiple, thence through the two sides or portions of the multiple arc circuit comprising the transmitting circuit.

I will describe my invention more particularly with reference to the accompanying drawings, in which—

Figure I illustrates two subscribers' lines connected together for conversation after the manner of my invention. Fig. II illustrates my invention in connection with a modification of the apparatus at the subscribers' stations.

Referring more particularly to Fig. I, the line of subscriber A extends in two limbs a a' to the central station and terminates thereat in line springs a^2 a^3 in the ordinary manner. One of the line springs a^3 normally rests against a back contact a^4 connected to ground through an individual indicator a^5, and a battery b. The limb a of the telephone line is connected at the subscriber's station with the telephone hook c which when the subscriber's telephone is on its hook makes contact with the terminal c' connected through a bell c^2 to ground. When the telephone is removed from its hook the hook c makes contact with the terminal c^3 connected by conductor c^4 with the secondary d' of the induction coil d through the telephone receiver e and by conductor e' with contact terminal e^2 which when the telephone is off from the hook makes contact with an insulated plate e^3 mounted upon the telephone hook and connected with the limb a' of the line. The conductors c^4 and e' are united by a conductor e^4 which is connected by a branch e^5 with the point f' of the local or transmitter circuit f. Represented in double lines. The branch e^5 is connected between the two members of a retardation coil e^6. In one of the branches f^2 of the local or transmitter circuit is included the microphone g while in the other branch f^3 is included the primary of the induction coil. The point f^4 of the local circuit is connected to ground. The subscriber B is provided with similar apparatus similarly connected with the central office and for the purpose of clearness I have indicated the several parts of the apparatus by the same letters as before employed in connection with subscriber A.

At the central station are provided a number of pairs of cord sets a pair being illustrated complete and comprising plugs h h' which are shown inserted in the spring jacks of the lines A and B respectively. The plugs are united by a sleeve strand h^2 and a tip strand h^3 clearing out indicators h^4 h^5 being included in one of the strands, as the sleeve strand, on opposite sides of a branch conductor h^6 uniting the tip and sleeve strands. In the branch h^6 is included a retardation coil h^7 from the middle of which extends a conductor h^8 to the pole of the battery b. A generator i is included with a ringing key i' in a grounded branch from the tip strand h^3.

Suppose subscriber A desires a connection with subscriber B. He removes his telephone from its hook thus completing the circuit of battery b through individual indicator a^5, contact a^4, line spring a^3, limb a', contact e^2, conductors e' e^4 e^5, through the two branches of the local circuit to ground, thus actuating indicator a^5 and calling the attention of the operator who inserts one of the plugs as h into the spring jack of subscriber A thus opening the circuit through individual indicator a^5. The operator then bridges in her telephone set which may be of the ordinary construction and which for clearness has been omitted, and receives the number of the called subscriber. Supposing it to be subscriber B she inserts the other plug h' of the cord set into the spring jack of line B. She then depresses the ringing key i' thus sending a ringing current from the generator over strand h^3, limb a of subscriber B and through his bell c^2 to ground. Subscriber B lifts his telephone from its hook and the subscribers are in conversation. Supposing subscriber A to be speaking into his microphone, the circuit of battery b may be traced to conductor h^8, then dividing one branch passing by tip strand h^3, line spring a^2, limb a of the line of subscriber A, hook c, contact c^3, conductor e^4 to branch e^5, the other portion of the current passing from the conductor h^8 to sleeve strand h^2, line spring a^3, limb a' of the line of subscriber A, conductors e' and e^4 to

branch e^5. From branch e^5, the current passes by the branches f^2 f^3 of the transmitter circuit f to ground. The variation of resistance in the branch f^2 by means of the microphone causes a corresponding undulation of current in the primary coil of the induction coil d thus inducing current in the secondary d' of the induction coil. The current thus induced in coil d' may be traced through receiver e, conductor e', limb a', strand h^2 to limb a' of the line of subscriber B, conductor e', telephone e of subscriber B, coil d' of his induction coil, conductor c^4, limb a of the line of subscriber B to the tip strand h^3, thence to limb a of the line of subscriber A, his telephone hook c, limb c^4 and back to the coil d'. When the subscribers are through conversation by hanging up their telephones the clearing out indicators h^4 h^5, may be actuated to send in the clearing out signal.

The voice currents are prevented from passing through the branches e^4 h^6 by the interposition of the retardation coils e^6 h^7 included therein.

In the modification shown in Fig. II I have illustrated the local transmitter circuit as containing two induction coils d and k, the one being included in one of the branches f^2 while the other is included in the other branch f^3, the microphone g being included in branch f^2. As the microphone is operated the current through the branch f^2 is increased while the current through the branch f^3 is decreased, currents being thus induced in the secondaries of the induction coils which are so connected that the electro motive forces of the induced currents are added. A resistance coil l is shown included in the branch f^3 whereby the resistance of the branches may be adjusted.

I have found that the best results are obtained when the two branches of the local transmitter circuit possess the same or approximately the same resistance.

In case two induction coils are employed in each of the transmitter circuits as illustrated on the right in Fig. II, the telephone may be placed in a bridge across the branches or limbs of the telephone line and the retardation coil as e^6 of Fig. I may be omitted. As illustrated on the left in Fig. II a retardation coil e^6 is included in the conductor e^4 connected across the limbs of the telephone line, while the telephone receiver is connected in series with the secondaries of the induction coils. As illustrated, I have utilized the telephone wires as feeders for the transmitter circuits. It is evident however that in some instances it might be found economical and desirable to run a special wire to supply some particular group of transmitter circuits as for example those of the subscribers in a particular building. The switching apparatus at the central office I have illustrated as adapted to automatically direct current to the transmitter circuits of the different lines respectively as connections are made with the lines.

Any suitable apparatus whereby current may be directed over different feeding circuits to supply current to transmitter circuits and cause the current to traverse such transmitter circuits respectively in multiple arc may be used in carrying out my invention.

By a transmitter circuit I mean any circuit including a microphone or transmitter and which is inductively connected with a telephone line. In carrying out my invention it is desirable that the resistance of the two portions of the multiple arc circuit of the transmitter circuit should be not greatly different. For example, as illustrated in Fig. I, the transmitter g is included in one branch and the primary coil of the induction coil is included in the other branch, the resistance of said primary coil and that of the transmitter g being fifteen ohms each. As the resistance of the branch containing the transmitter is for example increased its current will be diminished while current through the primary coil of the induction coil d will be thereby increased, that is to say, speaking generally, the change in the impact of the electrodes of the transmitter causes opposite changes in the current traversing the two sides or portions of the multiple arc circuit of the transmitter circuit. The changes in current strength in one side or branch are therefore inversely to the changes of current strength in the other side of the multiple arc circuit.

In case two or more subscribers are placed on the same telephone line, each will be provided with his own transmitter circuit and usual apparatus. It is not uncommon to thus place five or six subscribers upon one telephone line and a common battery may be thus used for such a group of transmitter circuits. As shown in the drawings, the subscribers' stations A and B are each upon a separate telephone line and when connected as shown, the current is directed in parallel through each of the transmitter circuits. The switching apparatus where the battery is placed is such that current may be directed in multiple through the different transmitter circuits independently and from time to time as desired. The transmitter circuits of the subscribers' stations A and B are in parallel with one another and in circuit with the battery, so that either subscriber may connect his transmitter circuit with the battery by removing his telephone, thus operating his switching apparatus, or, both subscribers may connect themselves with the battery by the removal of their telephones, the transmitter circuits of the two talking subscribers being thus connected in circuit in parallel.

As to the prior state of the art, reference is made to Letters Patent No. 330,056, granted Charles E. Scribner November 10,1885, for a battery circuit for telephone exchanges. As thus shown, the transmitter circuits are permanently connected with the feeding circuit in series, means being provided for closing a shunt circuit around the transmitter cir-

cuit at each of the stations when the telephone is not in use. Such a system has not to my knowledge been put in practice, and in my judgment it would not be practicable to feed the transmitter circuits in series as shown in said Scribner patent, since the voltage of the battery required for a considerable group would be excessive.

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

1. The combination with a metallic circuit telephone line extending in two limbs to the central station, said limbs being united at the sub-station, of a connection to ground or common return from said united limbs at the sub-station, a local transmitter circuit included in said connection, and comprising two parallel paths in which are included the microphone and the primary inductive winding, a battery or source of current at the central station, connected with ground or said common return, means for preventing the leakage of voice currents at the central station through said common return, and switching apparatus at the central station adapted, when connection is made with the line, to close together the two limbs of the telephone line and to connect the same in circuit with said battery; whereby current is directed over the two limbs of the telephone line in parallel and through the parallel paths comprising the local transmitter circuit; substantially as described.

2. The combination with a telephone line extending in two limbs to the central station, of a secondary inductive winding included in each of said limbs at the sub-station, said limbs being united at the sub-station, a connection to ground or common return from said united limbs, a local transmitter circuit included in said connection and comprising two parallel paths, a primary winding included in each of said parallel paths, a microphone included in said local transmitter circuit, and a battery at the central station connected between said ground or common return and the united limbs of said telephone line; substantially as described.

3. In a telephone system, the combination with a telephone line extending in two limbs to the central station, of a cord set thereat adapted to be connected with the line, a bridge between the two strands of the cord set, a retardation coil included in said bridge, a battery in a common return conductor or ground return connection from the middle of said retardation coil, a bridge at the sub-station across the two limbs of the line, a retardation coil in said bridge, a common return or ground branch extending from the middle of said retardation coil, a local transmitter circuit interposed in said branch and containing the microphone and the primary of an induction coil, said branch being connected with said local transmitter circuit at two points to include the same in circuit with the battery in two or more multiple or parallel branches, and the secondary of said induction coil included in circuit between the limbs of the telephone line, substantially as described.

4. The combination with a local transmitter circuit comprising two parallel branches, of two induction coils having their primaries included one in each of the branches of said transmitter circuit, and their secondaries included in the telephone line in series, a microphone included in said transmitter circuit, and a battery adapted to direct current through said branches in parallel.

5. The combination with a local transmitter circuit comprising two parallel branches, of a primary inductive winding included in each of said parallel branches, a microphone included in said transmitter circuit, secondary windings situated in inductive relation to said primary windings and connected in circuit with the telephone line, and a battery adapted to direct current through the branches of said local transmitter circuit in parallel.

In witness whereof I hereunto subscribe my name this 12th day of February, A. D. 1895.

WILLIAM W. DEAN.

Witnesses:
GEORGE P. BARTON,
W. CLYDE JONES.