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W. W. DEAN.

TELEPHONE SYSTEM.

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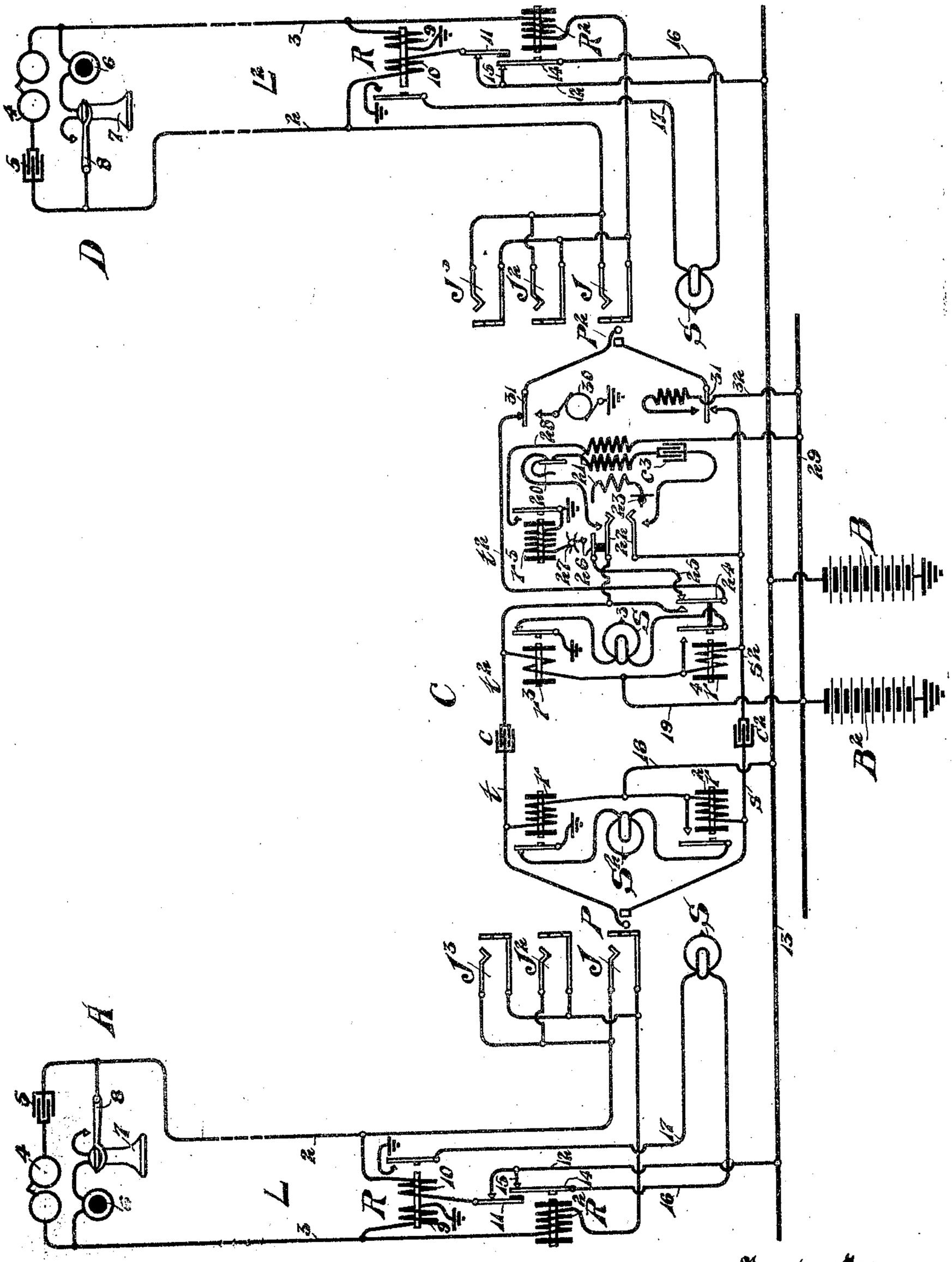

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TELEPHONE SYSTEM.

No. 887,071. Specification of Letters Patent. Patented May 12, 1908.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems of the common battery type, and more particularly to systems in which a pair of sources of current at the central office are provided, one of said sources being connected with the calling line and the other with the called lines during conversation. It has been common heretofore in subscribers' lines of the latter type to disconnect the battery from the line when connection was established with calling lines, thereby causing a noise in the waiting subscribers' receivers to such an extent as to result in considerable annoyance to them.

My invention has for one of its objects to obviate to a great degree, if not entirely, the noise in the waiting subscriber's receiver, and this is preferably accomplished by not severing the normal connection of the central source of current therewith when the operator connects her cord circuit with the line in response to the subscriber's call. In completing the connection for conversation, I preferably so arrange the apparatus that the second source of current is connected with the called line, so that the two lines are supplied with current for talking from the two batteries.

A further object of the invention is to thus apply the second battery to the called subscribers' lines through the medium of the cord circuit itself.

Other objects are to simplify the apparatus required for systems of this type, and to produce a thoroughly operative and efficient system with the least complication and additional expense possible.

Still further objects and advantages of the system will hereinafter appear.

My invention is illustrated in the accompanying drawing in which the figure is a diagram of a telephone system embodying my improvements.

In this figure, L and L^2 indicate two subscribers' lines extending in two limbs 2 and 3 from their respective substations A and D to the central office C. The subscriber's outfit comprises the usual signaling bell 4, the condenser 5 in a permanent bridge of the line conductors, and a transmitter 6, the receiver 7 in a second bridge of said conductors that is normally held open at the switch hook 8 by the weight of the receiver suspended therefrom. This arrangement is intended merely to be typical of any usual or desired common battery outfit.

At the central office the subscriber's line is provided with the usual line signal S, an answering jack J and a plurality of multiple jacks such as J^2 and J^3 in any desired number, according to the capacity of the multiple switchboard upon which they are located. The telephone line is also fitted with a line relay R and with a cut-off relay R^2, the latter being included in the sleeve line conductor 3, while the former is provided with windings 9 and 10, the former being legged to ground from the line conductor 3, while the latter is connected between the line conductor 2 and the spring 11 of the cut-off relay R^2, the normal contact of said relay being electrically united through the medium of a conductor 12 with the common battery lead or omnibus bar 13 connected with the live pole of the central common battery B. The said cut-off relay R^2 is provided with an additional spring 14, the normal contact of which is connected by a branch conductor 15 with said wire 12 and is itself joined by a conductor 16 with one side of the line signal S which is preferably in the form of a small incandescent lamp. The other terminal of said signal is joined by a conductor 17 with the spring of the line relay R, the forward contact of which is grounded.

The operator's outfit comprises a plurality of cord circuits, one only being shown and each cord circuit including an answering plug P and a calling plug P^2 having tip and sleeve contacts adapted to register with the corresponding contact surfaces of the spring jacks of the lines when inserted therein. The tip contacts of said plugs are united with the flexible strands t and t^2 and the interposed condenser c, while the sleeve contacts thereof are similarly joined by the strands s and s^2 and the interposed condenser c^2. Across the answering end of the cord circuit, a pair of supervisory relays r and r^2 are bridged, the former controlling through its normally closed contacts and the latter through its normally open contacts the local circuit of the supervisory signal S^2 associated

with the answering plug P. An intermediate point of said bridge is joined by branch conductor 18 with the said battery lead 13. A second pair of supervisory relays r^3 and r^4 are bridged across the calling end of the cord circuit and together control in a similar manner the local circuit of the supervisory signal S^3 associated with the calling plug P^2. The bridge of these relays is likewise connected by a conductor 19 with the live pole of a second central common battery B^2. The operator's set, including a head receiver 20, the secondary of her induction coil 21, and a suitable condenser c^3 are adapted to be bridged across the calling end of the cord circuit by the springs 22 of any suitable listening key, her transmitter 23 and the primary of her induction coil being charged from any suitable source of current which may be either the battery B or B^2. The supervisory relay r^4 is provided with an additional spring 24 connected with the forward portion of the strand t^2 of the cord circuit and is adapted, upon the operation of the supervisory relay r^4, to complete the said strand t^2 for conversation; under normal conditions, the said forward portion of the strand is connected with a conductor 25 leading to an extra contact 26 upon the operator's listening key. When the listening key is operated, the spring 26 is connected with the high resistance and high impedance test relay r^5 that is preferably common to all the cord circuits of the operator's position, as is indicated by the branching lines from the point 27. This relay r^5 controls through its normally open contacts and the branch conductor 28 a local circuit containing the tertiary winding of the operator's induction coil 21, and connected with the common wire 29 leading from the live pole of the battery B^2. A suitable ringing generator 30 is adapted to be connected with the tip side of the line by the operation of the ringing key springs 31, 31, the sleeve side of the cord circuit being at the same time connected by conductor 32 with the live pole of the battery B^2.

In order that the calling subscribers shall be provided with current from one battery and the called subscribers with current from the other battery, I preferably make the supervisory relays r and r^2 associated with the answering end of the cord circuit of high resistance, say 5000 ohms each, while the corresponding pair of relays, namely r^3 and r^4 may be respectively of 100 and 500 ohms resistance. The line relay windings 9 and 10 may be of 100 ohms resistance, and the cut-off relay R^2 should be of such resistance that it will not be actuated sufficiently to lift the spring 11 from its normal contact when connected in series with the answering end of the supervisory relay r^2 but will be actuated fully to lift the said spring 11 from its normal contact whenever connected in circuit with the sleeve supervisory relay r^4 associated with the calling end of the cord circuit. The electrical dimensions of the other parts of the apparatus may be such as are ordinarily used or as preferred.

The operation of my invention is as follows:—Assuming that the subscriber A desires to converse with subscriber D, he takes up his receiver, thereby closing the path for current from the battery B, over conductors 13 and 12, spring 11, the winding 10 of the line relay R, line conductor 2, through the substation device and thence back to the central office over line conductor 3 and through the winding 9 of said line relay R to ground. The current flowing in this path actuates the line relay R and closes the local circuit of the line signal from the said battery lead 13 through conductors 12 and 15, spring 14 of the cut-off relay R^2, conductor 16, through the said lamp conductor 17 and the closed contacts of said line relay R to ground. The signal is thus lighted and upon observing the same the operator inserts the answering plug P of her cord circuit in the answering jack J of the calling telephone line and connects her instrument with the cord circuit through the medium of her listening key 22. The insertion of the plug P closes a path of current from the battery B over conductors 13 and 18, through the sleeve supervisory relay r^2, which is of high resistance, the strand s of the cord circuit, sleeve contacts of the plug and jack, and thence over the line conductor 3 including the winding of the cut-off relay R^2 and through the winding 9 of the line relay R to ground. Owing to the high resistance of the supervisory relay r^2, the said cut-off relay R^2 is actuated only sufficiently to remove its spring 14 from the normal contact, thereby opening the circuit of the line signal S and retiring the same. The spring 11 of said relay R^2 is not now lifted from its normal contact so that the current from the battery B continues to be supplied to the telephone line L over the path just traced for the condition when the subscriber was calling the central office. In addition to this path for current through the winding 10 of the line relay R, there is a parallel path through the conductor 18, the tip strand t of the cord circuit and thence over the line conductor 2 to the substation. This supervisory relay thus receives sufficient current to actuate the same to open the local circuit of the supervisory signal A which in consequence remains unlighted. It is thus apparent that the battery current is mainly fed to the substation through the path originally traced and that the change of potential upon the line remains practically constant during the operation of connecting the cord circuit therewith so that the subscriber is not disturbed by noise in his receiver.

Upon learning the order of the subscriber wanted, his line is tested in the usual manner to determine its idle or busy condition. It will be observed that the test contacts of the lines are normally grounded through the winding 9 of the line relay R and since the tip of the calling and testing plug is likewise grounded through the test relay r^5 by reason of the supervisory relay r^4 not yet being operated and the listening key 22 being depressed, no flow of current results and the operator knows that the line is idle. In case the line is engaged, however, said test rings are connected through the sleeve strand s or s^2 of the inserted plug with the live pole of either the battery B or B^2 and when the grounded tip of the plug is brought into contact therewith, a flow of current results sufficient to actuate the test relay r^5 which closes the local circuit through the tertiary winding in the operator's induction coil, and thus causes a click in her receiver, thereby notifying her that the line is busy. Assuming that the line is found idle, the calling plug P^2 is inserted in the multiple jack of the line before the operator, and the ringing key 31 is depressed. The act of inserting the plug P^2 closes a circuit over the conductor 19 and through the sleeve supervisory relay r^4, which is of less resistance than r^2 and of greater resistance than r^5, the sleeve strand s^2 of the cord circuit, the sleeve side 3 of the called line L^2, and through the cut-off relay R^2 of said line, and thence to ground through the winding 9 of the line relay R. The current in this path, owing to its low resistance, is sufficient to fully actuate said cut-off relay R^2 to cause it to not only open the local circuit of the line signal S, but also lift the spring 11 of said relay from its normal contact, thereby opening the normal connection with the battery B. The depression of the ringing key connects the generator 30 with the tip side of the line, thereby sending the ringing current out to the substation and operating the signaling bell thereat, and thence returns to the central office through the sleeve strand of the cord circuit, the conductor 32, common wire 29 and through the battery B^2 to ground. At the same time current from the battery B^2 through said conductors 29 and 32 is supplying current for the continued operation of the cut-off relay R^2, which thus prevents false signals at the answering section of the switchboard upon which the calling signal of said line is located. As soon as the subscriber has been called, but before his response, the supervisory relay r^4 is actuated over the path just traced and closes the local circuit of the supervisory signal S^3, which is lighted, and indicates to the operator the condition of the called subscriber's telephone. The strand t^2 of the cord circuit is likewise now completed for conversation through the spring 24 of said supervisory relay and when the subscriber answers by taking up his receiver, current flows from said battery B^2 through the supervisory relay r^3, thence over the strand t^2 and the tip side of the line to the substation, with return over the line conductor 3, and through the winding 9 of the line relay, thus actuating the supervisory relay r^3 and retiring the signal S^3. During conversation, therefore, the battery B is furnishing current to the line L for conversation, and the battery B^2 is furnishing current to the line L^2 for a similar purpose. Thus the lines are independently supplied with operating current from said batteries B and B^2. It will be observed that the spring 14 of the cut-off relay R^2 is insulated from the spring 11 by the small piece of insulation mounted upon the end of the latter.

Having thus described my invention in one commercial form what I claim is:—

1. In a telephone system, the combination with a plurality of telephone lines, of a pair of sources of current at the central office to furnish current over said lines for conversation, a cut-off relay for each line, one of said sources of current being normally connected with the lines to furnish current thereover while the subscribers are calling the central office, an operator's cord circuit, means for actuating said cut-off relays in one manner when the cord circuit is connected with the calling subscriber's line to render the line signals of said lines inoperative and to leave the connection of said source with said lines undisturbed, means for operating the cut-off relays in a different manner when the cord circuit is connected with the called lines to not only render the signals of said lines inoperative during connections but to also disconnect the said source from the said lines and means to at the same time connect the other of said sources to the latter lines to furnish current thereover for conversation, substantially as described.

2. In a telephone system, the combination with a plurality of telephone lines, of a pair of sources of current at the central office, one of which is normally connected with said lines to furnish current thereover when the subscriber is calling the central office, an operator's connective circuit for establishing connections between the lines for conversation, a cut-off relay for each line adapted when only partially operated to render the line signal inoperative and when wholly operated to render said signal inoperative and at the same time sever the normal connection of said source, and means whereby when the said cord circuit is connected with the calling lines said cut-off relays are only partially operated and when the said circuit is connected with the called lines the cut-off relays of the lines are completely operated, said second source of current being at the same

time connected with the said called lines, substantially as described.

3. In a telephone system, the combination with a plurality of telephone lines each having a line signal, of a cut-off relay for each line, a pair of sources of electricity one of which is normally connected with the lines to enable the subscribers to call the central office, a cord circuit to connect the lines together for conversation, a circuit established through the said cut-off relays by the cord circuit when connected with the lines, a high resistance included in the circuit so established by one end of the cord circuit and a low resistance included in the circuit established by the other end of the said cord circuit whereby in each complete connection the normally connected source remains connected with one line and is cut off from the other, and means for connecting the second source to the latter line, substantially as described.

4. In a telephone system, the combination with a plurality of telephone lines each having a line signal, of a cut-off relay for each line, a pair of sources of electricity one of which is normally connected with the line to enable the subscriber to call the central office, a cord circuit to connect the lines together for conversation, a circuit established through the said cut-off relays by the cord circuit when connected with the lines, a high resistance connected with the answering end of the cord circuit and a low resistance with the calling end, and means whereby when the cord circuit establishes connection between two lines the high resistance device is included in circuit with the cut-off relay of the calling line to permit said normally connected source to remain in connection therewith and said low resistance device is connected in circuit with the cut-off relay of the called-for line to permit said relay to be operated and thereby to disconnect said source, the second source of said pair being at the same time placed in connection with the latter line, substantially as described.

5. In a telephone system, the combination with a plurality of telephone lines each having a line signal and a cut-off relay, of a pair of sources of electricity with one of which said lines are normally connected through contacts of the cut-off relays, a cord circuit to establish connections between the lines for conversation, a high resistance device connected with the answering end of the cord circuit and adapted to be included in a local circuit with the cut-off relay when connection is established with a calling line and a low resistance device connected with the calling end of the cord circuit and adapted to be similarly connected in a local circuit with the cut-off relay of the called line when the calling cord is connected therewith, said resistances being so proportioned relatively to the cut-off relays and other parts included in the local circuits that the cut-off relay of the calling line is actuated only sufficiently to render the line signal inoperative, the normally connected source remaining in connection with said line, and the cut-off relay of the called line to be completely operated to render the line signal inoperative and to sever the connection of the normally connected source therewith and means for at the same time connecting the second source with the latter line, substantially as described.

6. In a telephone system, the combination with a plurality of telephone lines each having a line signal and a cut-off relay controlling the circuit of the signal, of a pair of sources of electricity with one of which said lines are normally connected to enable the subscribers to call the central office, a cord circuit, means for completing a local circuit through the cut-off relays of the lines when the cord circuit is connected therewith, a high resistance supervisory relay associated with the answering end of the cord circuit and adapted to be included in said local circuit during a connection, a low resistance supervisory relay connected with the calling end of the cord circuit and likewise adapted to be included in the local circuit of the cut-off relay of the called line during a connection, the resistance of said relays being so adjusted that the cut-off relays of the calling lines are actuated only sufficiently to render the line signals inoperative and to permit the normally connected source to remain in connection therewith while the cut-off relays of the called lines are fully actuated to render the line signals inoperative and to disconnect said normal current source, and means for at the same time connecting the second source of current with the latter line, substantially as described.

7. In a telephone system, the combination with a plurality of telephone lines, of a source of current at the central office normally connected with said lines to furnish current for signaling, a cord circuit, and a second source associated therewith, means during conversation to furnish transmitter current from said first source only to the calling telephone line and from the second source only to the called telephone line, substantially as described.

8. In a telephone system, the combination with a plurality of telephone lines, of line signals and cut-off relays therefor, a source of current normally connected with the lines through contacts of the cut-off relays to provide current for signaling the central office from the substations, answering and multiple jacks connected with the lines all having the same circuit relation to the cut-off relays, a cord circuit, means associated with the cord circuit for suitably controlling said cut-off relays whereby when connection is established

with the answering end of the cord the cut-off relay is operated to render the corresponding line signal inoperative but not to sever the connection of said source and when connection is established by the calling end of the cord circuit the cut-off relay of the line so connected is operated to not only render the line signal inoperative but to also disconnect said source, and a second source connected with the latter lines, substantially as described.

9. In a telephone system, the combination with a plurality of telephone lines, of a source of current with which the lines are normally connected, a cord circuit, means when connection is established by one end of the cord circuit whereby said source remains in connection with the line and alone feeds current thereto for conversation, a second source of current, and means when the other end of the cord circuit is connected to the second line whereby current from said second source is fed to the second line only through said cord circuit, substantially as described.

10. In a telephone system, the combination with a plurality of telephone lines, of a cord circuit to connect said lines for conversation, of two sources of direct current for said lines, of a line relay for each of said lines, said relay having two windings, and means whereby current from one or the other of said sources is furnished to the line through the coils of the line relay or through the connection of said cord circuit according to whether the line is a calling or a called telephone line, substantially as described.

11. In a telephone system of the central energy type, the combination with a plurality of telephone lines, of two sources of current for said lines at the central office, means whereby energy from one of said sources may be normally maintained on all of said lines, and further means when two lines are placed in condition for conversation whereby one of said lines will receive talking current only from one of said sources, and whereby the other of said lines will receive its energy only from the other source, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 5th day of November 1903.

WILLIAM W. DEAN.

Witnesses:
GAZELLE BEDER,
E. A. GARLOCK.