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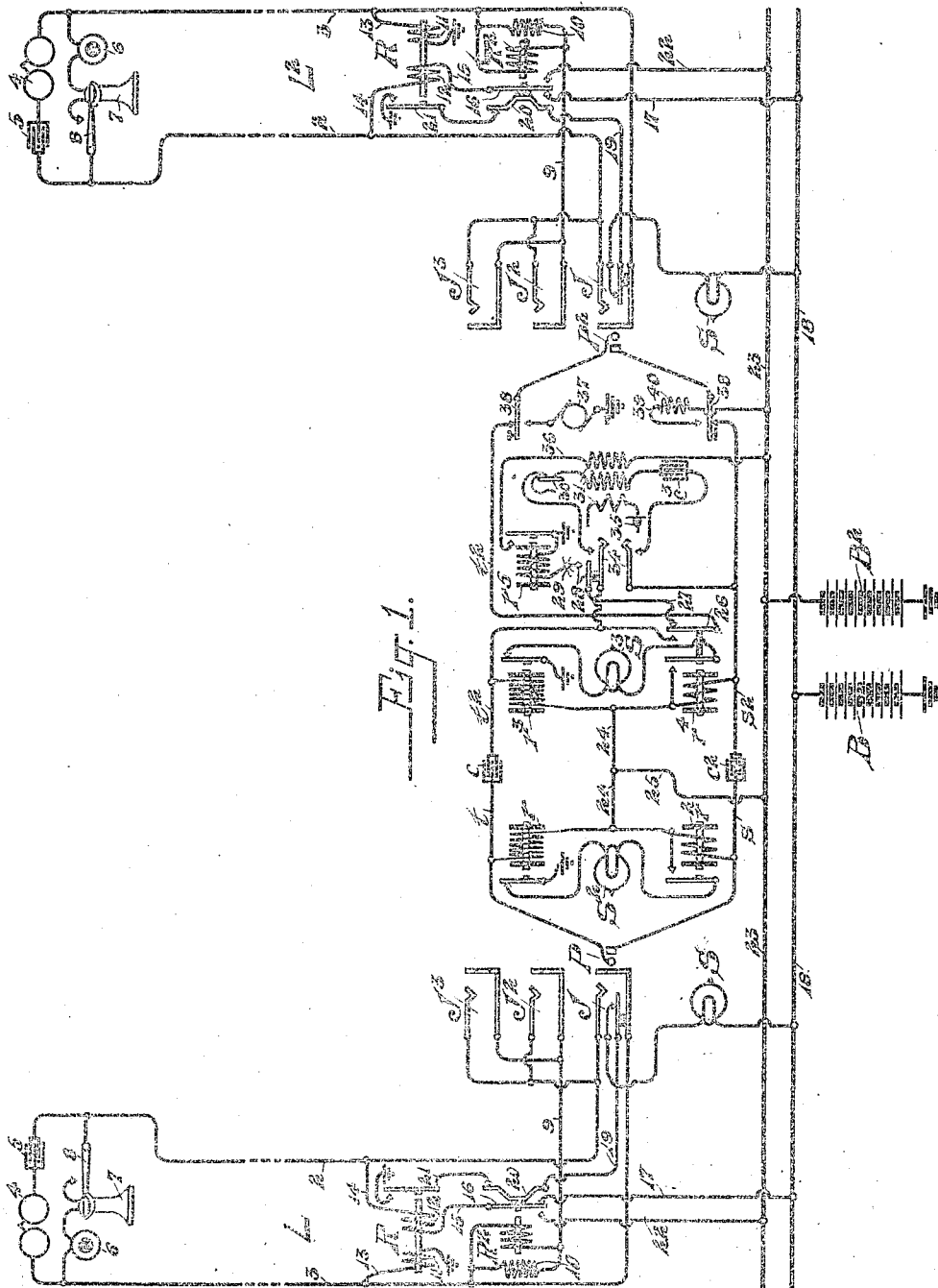
PATENTED JAN. 21, 1908.

H. M. POST.

TELEPHONE SYSTEM.

APPLICATION FILED NOV. 11, 1903.

2 SHEETS—SHEET 1.



Witnesses.
R. H. Bonfired
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Inventor:
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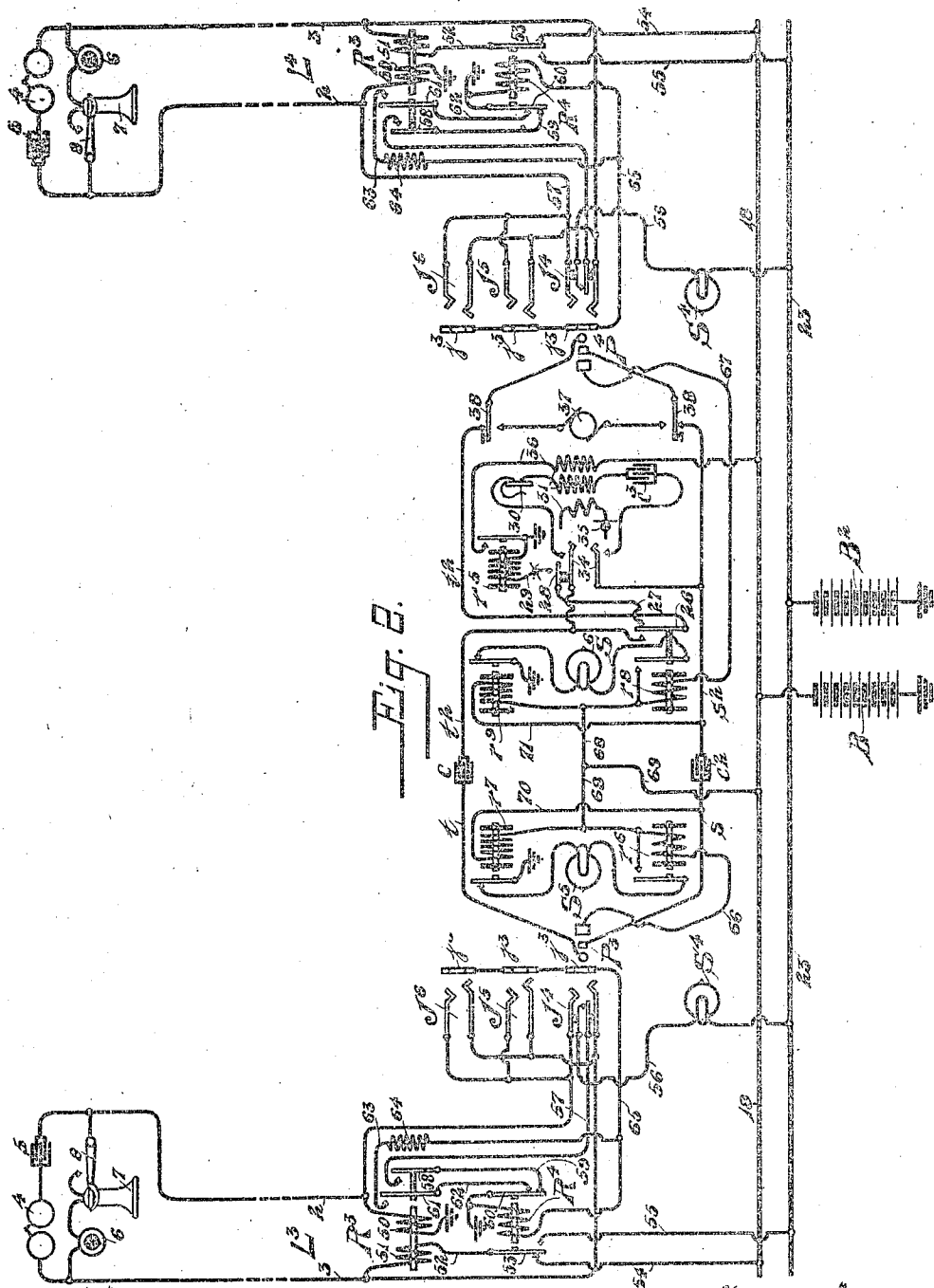
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2 SHEETS—SHEET 2.



Witnesses.

R. H. Burfield
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UNITED STATES PATENT OFFICE.

HOWARD M. POST, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

No. 877,121.

Specification of Letters Patent.

Patented Jan. 21, 1908.

Application filed November 11, 1903. Serial No. 180,684.

To all whom it may concern:

Be it known that I, HOWARD M. POST, 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 improvements in telephone systems of the common battery type.

It is often desired for various reasons to employ two sources of current at the central office, to supply the subscribers' lines with current for conversation, one of these sources being connected with the calling lines and the other source being connected with the called lines. In the systems that have been heretofore devised for this purpose in which the lines of each connection were so provided with current from the separate sources, the battery connected with the calling line was disconnected when the operator inserted her cord circuit plug into the spring jack of the calling line thereby breaking the normal connection of said line with its source and again connecting a source therewith. In thus severing the normal connection of the battery with the calling line, a disagreeable noise is caused in the waiting subscriber's receiver.

One object of the present invention is to so arrange the said source of current and the apparatus at the central office that no great variation of potential takes place upon the calling line when the operator answers the call whereby the disagreeable noise in the subscriber's receiver is prevented. To accomplish this, I preferably arrange the apparatus so that the normal connection of the battery with the calling line remains undisturbed when the operator answers the call, and at the same time the other source of current is connected with the called line to supply current thereto for conversation.

In carrying out my invention, which is worked out for commercial purposes I so arrange the cut-off relays of the lines which are ordinarily employed to sever the battery connection so that they do not respond when a connection for conversation is established with the calling line but do respond to sever said connection when the connection is completed with the called line. In the specific arrangement that I have worked out, I preferably also so arrange said cut-off relays as to connect the second battery with the called line when the connections are so completed.

Other objects of my invention are to provide a system that is a practically and commercially operative one, that is simple and inexpensive to manufacture and install, and one that is efficient and durable in operation.

Still other objects and advantages will appear from the detailed description and claims.

My invention is illustrated in the accompanying drawing in which

Figure 1 is a diagram of a telephone system showing my improvements applied to subscribers' lines of the two-wire type, and Fig. 2 is a similar diagram showing the invention applied to lines of the three wire type.

The same reference letters are used throughout to designate similar parts.

Referring to Fig. 1, L and L² indicate subscribers' lines extending in two limbs 2 and 3 from their respective substations to the central office where they terminate in the usual apparatus. At the substation I have indicated any usual or desired common battery outfit by the ordinary signaling bell 4 and a condenser 5 in a permanent bridge of the line conductors and the transmitter 6 and receiver 7 in a second bridge which is normally open at the switch hook 8.

At the central office the line is provided, as is usual, with an answering jack J, and with a plurality of multiple jacks such as J² and J³, in any number, and with a line signal S, preferably in the form of a small incandescent lamp. The line conductors 2 and 3 are extended directly through to the corresponding tip and sleeve contacts of the answering jack J, the tip contacts of the multiple jacks being connected directly with the same line conductor, but the sleeve contacts of the multiple jacks are connected by conductor 9 with the winding of a cut-off relay R² and thence to the sleeve conductor 3, said relay R² being shunted by a noninductive resistance 10 to permit the ready passage of the voice currents. The line relay R is provided with a pair of balancing windings 11 and 12, the former being legged to ground by conductor 13 from the sleeve conductor 3, and the latter being joined upon one side by conductor 14 with the line conductor 2 and upon the opposite side by conductor 15 with a spring 16 of the cut-off relay R², the normal contact of which is joined by a branch conductor 17 with the common lead or wire 18

connected with the live pole of the central common battery B. The local circuit of the line signal is completed from said battery lead 18 through the lamp S, through the normally closed contacts of the answering jack J thence by conductor 19 with an additional spring 20 of said cut-off relay R^2 , the normal contact of which is connected by conductor 21 with one of the normally open contacts of the line relay R, the other of which contacts is grounded. The forward contact of the spring 16 of relay R^2 is joined by a suitable conductor 22 with the battery lead or common wire 23 extending to a second central and common battery B^2 .

The operator's outfit comprises a plurality of cord circuits, one only being shown in the diagram, each of which is provided with an answering plug P and a calling plug P^2 having tip and sleeve contacts adapted to register with the corresponding contacts of the spring jacks when inserted therein, the tip contacts of said plugs being united through the flexible strands t and t^2 and the interposed condenser c , while the sleeve contacts are similarly joined by the strands s and s^2 and the interposed condenser c^2 . A pair of supervisory relays r and r^2 are connected across the answering end of the cord circuit, 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 , that is associated with the answering plug P. An intermediate point of the bridge of these relays is connected by means of conductors 24 and 25 with said battery lead 23 which extends to the live pole of the battery B^2 . A second pair of supervisory relays r^3 and r^4 are bridged across the calling end of the cord circuit, and similarly control the local circuit of the supervisory signal S^3 , that is associated with the calling plug P^2 . The tip strand t^2 of the cord circuit is normally open at an additional spring 26 of the supervisory relay r^4 , which connects the forward portion of said strand through conductor 27, the normally open contacts 28 of the operator's key with the high resistance and high impedance test relay r^5 that is preferably common to all of the cord circuits at each operator's position as is indicated by the branching lines from the point 29.

The operator's head receiver 30, the secondary of her induction coil 31, and a suitable condenser c^3 are adapted to be bridged across the calling end of the cord circuit by the springs 34 of any suitable listening key, the primary of said coil 31 and her transmitter 35 being charged from any suitable source of current which may be either the battery B or B^2 . The test relay r^5 controls through its normally open contacts a circuit from the battery lead 23, through the branch conductor 36 including the tertiary winding of the

operator's induction coil 31, which may be of any desired resistance.

A ringing generator 37 is adapted to be connected with the tip side of the line by the operation of the ringing key 38, 38, the sleeve side of the cord circuit being simultaneously connected by the sleeve spring of said key through conductor 39, and resistance 40 with said battery lead 23.

While the resistance or dimensions of the various parts are not of the essence of my invention, I have found good results with batteries B and B^2 of 24 volts each, the windings 11 and 12 of the line relays R of 100 ohms respectively, the cut-off relay R^2 and the non-inductive winding 10 of 200 ohms each, and the supervisory relays r and r^2 , as well as the corresponding pair r^3 and r^4 , of 500 and 100 ohms respectively, the other parts being of suitable or desired dimensions to properly operate with those specified.

In the operation of my invention, the subscriber upon the line L takes up his receiver, and thereby completes a path for current from the battery B over the common lead 18 and wire 17, spring 16, of the cut-off relay R^2 , wire 15, winding 12 of line relay R, branch conductor 14, the line conductor 2, thence through the substation devices and back to the central office over the line conductor 3 and conductor 13 through the winding 11 of the line relay R to ground. The current in this path actuates the line relay R to cause it to close the local circuit of the line signal S, said circuit extending from the battery lead 18 through the lamp S, the normal contacts of the answering jack J, conductor 19, spring 20 of cut-off relay R^2 , conductor 21 and the closed contacts of the line relay R to ground. Upon observing the signal the operator inserts the answering plug P of her cord circuit in the answering jack J of the calling line and connects her instrument with the cord circuit to learn the order of the subscriber. The insertion of the plug P opens the closed contacts of the jack J that are included in the circuit of the signal S, and retires the same. At the same time the supervisory relay r^2 is inclosed in a local circuit from the battery B over common lead 23, wires 25 and 24, the winding of the supervisory relay r^2 , sleeve strand s , sleeve contacts of the plug and jack, thence over conductor 3 of the telephone line to the branch conductor 13 and thence through the winding 11 of the line relay R to ground. The current in this path operates the said supervisory relay to close the local circuit of the lamp S^2 , but since the subscriber's telephone is now in use, a path for current is also provided through the high resistance supervisory relay r over the tip strand t and thence over the line conductor 2 to the

substation with return over the same path through the winding 11 of the line relay R. This supervisory relay r is therefore actuated and prevents the lighting of the supervisory signal S^2 . At this time it will be noticed that the cut-off relay R^2 is not operated so that the line L is fed through the normal contact to the spring 16 of this relay from the battery B. Therefore, the connection of the answering plug P of the cord circuit with the calling line does not greatly change the potential upon the said line and does not cause a disturbance in the waiting subscriber's receiver.

Upon learning the party wanted, the line is tested in the usual manner by touching the tip of the calling plug P^2 to the test ring of one of the multiple jacks of that line. It will be noted that said test rings are normally connected to ground through the winding 11 of the line relay R and since the tip of the plug is likewise grounded through the test relay r^2 no flow of current results when an idle line is tested and the operator knows that the line is not busy. When a connection exists with the line, however, said sleeve rings are connected with the live pole of the battery B^2 , through the sleeve strand of the inserted plug so that the touching of the tip of the testing plug to one of said test rings completes a path for current from said battery through test relay r^2 which is actuated to close the local circuit through the tertiary winding of the operator's induction coil, thus causing a click in her receiver, and notifying her that the line is busy. The connection of the test relay at this time with the conductor 27 is made through the contacts 28 of the listening key which is now in position to connect the operator's telephone with the cord circuit, as before stated. Assuming that the line is found idle, the calling plug P^2 is inserted in one of the multiple jacks and the ringing key 38, 38 is operated. The insertion of the plug P^2 closes a path for current from the battery B^2 over the common wire 23, conductors 25 and 24, through the supervisory relay r^2 , the strand s^2 of the cord circuit, the sleeve contacts of the plug and the multiple jack into which it is inserted, the conductor 9 through the winding of the cut-off relay R^2 and thence over the line conductor 8, and through conductor 13 including the winding 11 of the line relay R to ground. Current in this path is sufficient to actuate the said cut-off relay, which opens the circuit of the line signal through its spring 20, thereby preventing its operation during the connection and at the same time it serves through the medium of its spring 16 to sever the connection with the battery B, and to connect with the wire 22 leading to the common lead 23 from the battery B^2 . The line relay R may be simultaneously operated but does not result in lighting the signal lamp S

since its circuit is open at the contacts of the cut-off relay R^2 . Upon depressing the ringing key, the generator is connected with the tip side of the cord circuit, while the sleeve strand of the cord circuit is severed and its forward portion is connected directly with the battery B^2 , through the conductor 39 and resistance 40; the path for ringing current is then over the tip side of the line, through the signal bell at the substation, back to the central office over the line conductor 3 and over the conductor 9 and thence through the forward portion of the sleeve strand s^2 of the cord circuit, the conductors 39 and 23 and through the battery B^2 to ground. The cut-off relay R^2 is maintained actuated at this time by current from the battery B^2 which flows through the wires 23 and 39, conductor 9, and thence through the winding 11 of the line relay R to ground. After the subscriber has been called but before his response the supervisory relay r^2 is actuated as before described and serves to disconnect the conductor 27 and to complete the strand t^2 for conversation. At the same time the local circuit of the supervisory signal S^2 is closed and since the supervisory relay r^2 is not yet actuated, owing to the fact that the subscriber's line is still open, said signal is lighted and indicates to the operator that the called subscriber has not yet responded. Upon his response said relay r^2 is actuated by current from the battery B^2 flowing over the metallic line and the signal is rendered inert. It will be noted that the battery B is cut-off from the line L^2 during the connection of the cord circuit therewith and that the battery B^2 alone furnishes current to the said line for conversation. Thus during conversation the battery B, which is normally connected with all of the lines, furnishes current over the calling subscriber's line while the battery B^2 is utilized for furnishing current to the called subscribers' lines. It is apparent that the noise upon the calling subscribers' lines is greatly reduced, if not entirely prevented, by the fact that the battery is permanently connected therewith during the connection and is not severed and again connected by the plugging in in response to his call. The voice currents find a ready path over the two sides of the lines and the two sides of the cord circuit, and the condensers c and c^2 in the opposite strands of said circuit provide a ready means for transmitting currents from one line to the other. The non-inductive resistance 10 placed around the cut-off relay R^2 prevents impedance to the voice currents which might otherwise be encountered.

In Fig. 2 I show the invention applied to telephone lines of the three wire type, that is, of the type in which three wires extend throughout the multiple section of the switchboard for each subscriber's line, and in which the busy test contacts, as well as

the winding of the cut-off relay for each line, are included in the third conductor which is separate from the talking conductors. In this figure the subscriber's lines are indicated at L^2 and L^4 , the subscribers' stations being the same as in the prior figure and at the central office the lines are provided with line signals S^4 , with answering jacks J^4 and with multiple jacks J^5 and J^6 in any desired number. The line relay R^3 is provided with one winding 50 legged to ground from the tip side of the line and with a second winding 51 included in a conductor 52 leading to the spring 53 of the cut-off relay R^4 , the normal contact of said spring being joined by conductor 54 with the battery lead 18 connected with the live pole of the central common battery B. The forward contact of said spring 53 of the cut-off relay R^4 is joined by branch conductor 55 with the lead 23 from the second common battery B^2 . The line signal S^4 is connected upon one side with the battery lead 23 and upon the other with conductor 56 leading to normally closed contacts of the answering jack J^4 , said contacts being insulated from the talking contacts of the jack and thence by conductor 57 with the forward contact of the spring 58 mounted upon the line relay R^3 , and which is joined by another conductor 59 with a normal contact of the ground spring 60 of the cut-off relay R^4 . The line relay R^3 is provided with an additional spring 61 connected by a conductor 62 with a normal contact of said spring 60 of the cut-off relay R^4 and the forward contact of which is connected through a suitable conductor 63 including a resistance 64 with the third conductor 65 which is connected with the test rings j^3 of the jacks and which includes the winding of the cut-off relay R^4 , said relay being grounded at its opposite terminal. The cord circuit is of the three strand type to cooperate with the three wire line and includes in addition to the tip strands t and t^2 and the sleeve strands s and s^2 , the third strands 66 and 67, the strand 66 being connected with the third contact of the answering plug P^3 , including the winding of the supervisory relay r^6 , and is connected by conductors 68 and 69 with the live pole of the battery B. This relay is adapted to close the local circuit of the supervisory signal S^5 associated with said answering plug. A second supervisory relay r^7 is connected by a conductor 70 between conductor 68 and the sleeve strand s of the cord circuit and is adapted to be actuated during conversation to open the local circuit of the supervisory signal S^5 . A second pair of supervisory relays r^8 and r^9 are associated with the calling plug P^4 , the former being included in said third strand 67 of the calling plug and the latter in a conductor 71 extending between said conductor 68 and the sleeve strand s^2 of the cord circuit. These relays

suitably control the local circuit of the supervisory signal S^5 associated with the plug P^4 . The operator's set, including the test relay is the same as in the cord circuit of the previous figure, and is therefore, not specifically described, although it will be noted that in this instance a test relay need not be of high resistance or impedance, since the test contacts of the lines are not connected with the talking circuits. The ringing generator, however, is adapted to be connected across the metallic circuit of the cord circuit in the operation of the ringing key, instead of completing an extra battery connection with the said sleeve strand as in Fig. 1, this being rendered unnecessary since the cut-off relay is in said third strand, which strand is not severed in the operation of ringing.

When the subscriber desires a call, the taking up his receiver completes a current from the battery B over conductors 18 and 54, spring 53, conductor 52 including the winding 51 of the line relay, thence to the substation and back over the tip conductor 2 and through the winding 50 of the line relay R to ground. This actuates the line relay, causing it to close the circuit of the line signal S^4 , which may be traced from the battery lead 23, through the lamp, conductor 56, normally closed contacts of the answering jack J^4 , conductor 57, spring 58, conductor 59 and spring 60 of the cut-off relay R^4 to ground. Thus the signal is lighted and attracts the attention of the operator who inserts the answering plug P^3 of her cord circuit and connects her telephone with said circuit to receive the order. The operation of the line relay R^3 when the subscriber calls also results in closing a path for current in shunt of the cut-off relay R^4 , this path being completed from conductor 65 by means of wire 63, the forward contact and spring 61 of line relays R^3 , conductor 62, normal contact and spring 60 of the cut-off relay R^4 and since the said cut-off relay is preferably of about 500 ohms resistance, and the said resistance coil 64, which is preferably non-inductive, is of only 30 ohms resistance, the said cut-off relay will not be operated by the connecting of the plug P^3 with the answering jack, although by such operation the third contacts of the plug and jack are brought together and a path for current from the battery B is provided over conductors 18, 69, 68 and 66, and thence by way of conductor 65 through said relay and its parallel path. The normal connection of the battery B with the telephone line is therefore undisturbed and the subscriber is not annoyed by a change of potential of the current upon the telephone line. The line signal is retired by the act of making the connection since the normally closed contacts of the signal circuit in the answering jack are open, thus rendering the signal inert. At this time the supervisory relay r^6 is actuated

to close the local circuit of the supervisory signal S^3 , but since the subscriber's instrument is off its hook, a second path for current is completed through the supervisory relay r^7 and the sleeve strand s of the cord circuit, and over the telephone line, so that the local circuit of the signal is open and the lamp is prevented from operating. Upon finding that the wanted line is idle, the calling plug P^4 is inserted in one of the multiple jacks J^5 or J^6 of the line and the ringing key is operated in the usual manner. The insertion of the said plug completes a path for current over the thread strand 67 from the live pole of the battery B and through said conductor 65, including the winding of the cut-off relay R^4 to ground. This relay is not now shunted by the resistance 64 since the line relay R^3 is not operated so that said cut-off relay is actuated and serves both to open the local circuit of the line signal S^4 and to open the short circuit around itself. In addition it disconnects the spring 53 from the conductor 54, thus severing connection with the battery B and connects it with the conductor 55 leading to the live pole of the battery B^2 . Thus when the subscriber responds his line is charged by current from the battery B^2 which flows over the line and through the windings of the relay R^3 as before traced. The remainder of the operation of connecting the lines, supervising the same and carrying on conversation will be readily understood and it is thought unnecessary to go into further details. It will be noticed that during conversation the lines are independently charged with current from the separate batteries.

The resistance of the supervisory relays r^6 and r^8 may be about 200 ohms, while that of the cooperating relays r^7 and r^8 may be about 500 ohms. As in the former instance, the windings 50 and 51 of the line relays may be of 100 ohms each.

While I have thus specifically described my invention which has been worked out for commercial purposes, I do not wish to be limited in all respects to the specific details so described since it is obvious that various changes may be made without departing from the scope or principle of the same.

What I claim and desire to secure by Letters Patent 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, said lines being normally connected with one of said sources to furnish current thereover when a subscriber is calling the central office, an operator's connective circuit to establish connections with the calling lines and without severing the normal connection of said source therewith, and further means whereby when connection is established with the called lines the said second source is connected

therewith to furnish current for conversation, substantially as described.

2. In a telephone system, the combination with a plurality of telephone lines, a pair of sources of current at the central office, the said lines being normally connected with one of said sources which is adapted to furnish current thereover when the subscribers are calling, an operator's cord circuit, means to prevent a sudden or large change of potential upon the calling subscribers' lines when a connection is established by the cord circuit therewith, and means for connecting one of said sources with the calling lines and the other sources with the called lines during connections for conversation, substantially as described.

3. In a telephone system, the combination with a plurality of telephone lines, of a pair of sources of electricity at the central office, said lines being normally connected with one of said sources, an operator's cord circuit, means to prevent severing the normal connection with the lines that are calling the central office when the cord circuit is connected therewith, and means to disconnect said source from the lines that are called and to connect the other source with said latter lines when the connections for conversation are completed, substantially as described.

4. In a telephone system, the combination with a plurality of telephone lines, of two sources of current at the central office, said lines being normally connected with one only of said sources to furnish current thereover to enable the subscribers to signal the central office, said source also furnishing current to the calling lines for conversation, an operator's cord circuit to establish connections for conversation between the lines, and means for applying the other source to the called lines when connections are established therewith to furnish current thereover for conversation, substantially as described.

5. In a telephone system, the combination with a plurality of telephone lines each having an answering jack and one or more multiple jacks of a pair of sources of electricity at the central office to furnish current to the lines for conversation and with one of which sources the said lines are normally connected for signaling the central office, a cord circuit to establish connections between the lines for talking, and means whereby when the cord circuit is connected with the answering jacks said normally connected source remains connected with such lines and when the cord circuit is connected with the multiple jacks the other of said sources is connected with the latter lines, substantially as described.

6. In a telephone system, the combination with a plurality of telephone lines, of a signaling device and a cut-off relay for each line, a pair of sources of electricity, one of said sources being connected with said lines

through normally closed contacts of said relay to enable the subscribers to operate their signaling devices to call the central office, a cord circuit, and means whereby then the cord circuit is connected with the calling lines said relay contacts are undisturbed and said source remains connected with such lines and when connection is made with the called lines said relay is operated to disconnect said source, the other source, being at the same time connected with said called lines, substantially as described.

7. In a telephone system, the combination with a plurality of telephone lines, of a signaling device and a cut-off relay for each line, a pair of sources of electricity, one of said sources being connected with said lines through the normally closed contacts of said relays to enable the subscribers to operate their signaling devices to call the central office, a cord circuit, and means whereby when the cord circuit is connected with the calling lines said relay contacts are undisturbed and said source remains connected with such lines and when connection is made with the called lines the said relays of such lines are operated to disconnect said source and to connect the other source therewith, substantially as described.

8. In a telephone system, the combination with a plurality of telephone lines, of a signaling device and a cut-off relay for each line, a pair of sources of electricity, one of said sources being connected with said lines through the closed contacts of said relays to enable the subscribers to operate their signaling devices to call the central office, a cord circuit, and means whereby when the cord circuit is connected with the calling lines the cut-off relays of such lines remain inoperative and said source remains connected therewith and when connections is established with the called lines the cut-off relays of such lines are operated to disconnect said source and to connect said other source therewith, substantially as described.

9. In a telephone system, the combination with a plurality of telephone lines each having an answering jack and one or more multiple jacks, of a signaling device and a cut-off relay for each line, a pair of sources of electricity at the central office to furnish current to the lines for conversation and with one of which said lines are normally connected through contacts of said cut-off relays for signaling the central office, a cord circuit to establish connections between the lines for talking, and means whereby when connection is established by the cord circuit with the answering jacks the cut-off relays of such lines are not operated and said source remains connected therewith and when connection is established with the multiple jacks the cut-off relays of such lines are operated to dis-

connect said source and to connect said other source therewith, substantially as described.

10. In a telephone system, the combination with a plurality of telephone lines, of a line relay and a cut-off relay for each line, an answering jack and one or more multiple jacks for each line, a pair of sources of electricity one of which is normally connected with the lines through the line relays and normal contacts of the cut-off relays to furnish current thereover for signaling the central office, a line signal for each line the local circuit for each of which includes normally closed contacts of the answering jack and the cut-off relay of each line and normally open contacts of the line relay, a cord circuit to establish connections with the lines for conversation, and means whereby when the cord circuit is connected with an answering jack in response to a call the local circuit of the signal is opened at the answering jack contacts to retire the signal and the cut-off relay remains inoperative to permit said normally connected source to remain connected with the calling line, and when the cord circuit is connected with the multiple jack of the called line for subscriber the said cut-off relay is operated to open the local circuit and prevent the operation of the corresponding line signal and to disconnect said normally connected source and connect the other source with the said called line, substantially as described.

11. In a telephone system, the combination with a plurality of telephone lines, of a pair of common sources of electricity at the central office, a cord circuit to connect any of the lines together in pairs for conversation, and means for including said sources one to each line in every complete connection for conversation between any of the lines, the main path for current from said sources to the lines for the operation of the substation transmitters not including the cord circuit, substantially as described.

12. In a telephone system, the combination with a plurality of telephone lines, of a pair of sources of electricity at the central office, a cord circuit to connect any of the lines together for conversation, means for including said sources one to each line in every complete connection for conversation between any two lines of the system, the main current from said sources being fed to the lines for talking through the respective line devices, substantially as described.

13. In a telephone system, the combination with a plurality of telephone lines, of a line relay and a cut-off relay for each line, a source of current with which said lines are connected through the windings of the line relays and normal contacts of the cut-off relays to enable the subscribers to call the central office by operating their line relays, spring jacks connected with the lines on the

substation side of the line relays, a cord circuit having its two ends conductively discontinuous but inductively united, means whereby when connection is established with

5 the calling lines the said source remains connected therewith through the windings of the line relays and when connection is established with the called for lines said source is disconnected therefrom, and a second source
10 of current connected with the called for lines during conversation, substantially as described.

14. In a telephone system, the combination with a plurality of telephone lines, of a
15 line relay and a cut-off relay for each line, a source of current with which said lines are connected through the windings of the line relays and normal contacts of the cut-off relays to enable the subscribers to call the central
20 office by operating their line relays, spring jacks connected with the lines on the substation side of the line relays, a cord circuit having its two ends conductively discontinuous but inductively united, means
25 whereby when connection is established with the calling lines the said source remains connected therewith through the windings of the line relays and when connection is established with the called for lines said source is
30 disconnected therefrom, and a second source of current connected with the called for lines during conversation, said first source being disconnected by the cut-off relays of such lines and the second source connected there-
35 by also through the line relays windings, the said relay windings offering impedance to voice currents.

15. In a telephone system, the combination with a telephone line, of a central source
40 of signaling current a signal adapted to be actuated thereby, a cut-off relay, a cut-off jack, and means to control the circuit of said signal either at contacts of said jack or contacts of said cut-off relay, substantially as
15 described.

16. In a telephone system, the combination with a telephone line, of a line signal
therefor, a central source of signaling current a line relay for closing the circuit of said
50 signal, a cut-off relay, a cut-off jack, and means to open the circuit of said line signal either at the contacts of said jack or at the contacts of said cut-off relay, substantially as described.

55 17. In a telephone system, the combination with a telephone line, of a line signal therefor, a line relay for closing the circuit of said signal, answering and calling terminals for said line, cut-off contacts associated with
60 the answering terminal, a cut-off relay associated with the calling terminals, means to open the circuit of said signal at contacts of the jack when the cord circuit is connected with the answering terminal, and means to

open the circuit of said signal at contacts of
65 the cut-off relay when the cord is connected with a calling terminal, substantially as described.

18. In a telephone system, the combination with a plurality of telephone lines, of a
70 pair of sources of electricity at the central office, one of said sources being normally connected with the lines to furnish current there-
over when the subscriber is calling the central office, an operator's cord circuit, means where-
75 by when the cord circuit is connected with a calling line the connection of said source with said line remains undisturbed, and further means for disconnecting said source from the
called-for line and for connecting said other
80 source therewith through the medium of the cord circuit, substantially as described.

19. In a telephone system, the combination with a plurality of telephone lines, of a
85 pair of sources of electricity at the central office with one of which said lines are normally connected to enable the subscriber to call the central office, an operator's cord circuit, a cut-off relay for each line, means associ-
90 ated with each end of the cord circuit to suitably control the operation of said cut-off relays when connections are established with the lines whereby when connection is established with the calling line the normal connection of
the first named source of current therewith
95 remains undisturbed and when connection is established with the called for lines said battery is disconnected therefrom, the second battery being at the same time connected with the latter lines, substantially as described.
100

20. In a telephone system, the combination with a plurality of telephone lines, of
two sources of direct current therefor, means
for connecting one of said sources with all of the telephone lines to furnish current for the
105 line signaling apparatus, and means when two lines are placed in condition for conversation, whereby the talking current for the calling line is furnished from said first
source and the talking current for the called
110 line is furnished from the other source, substantially as described.

21. In a telephone system, the combination with a plurality of telephone lines, of a line
115 relay for each of said lines, two sources of direct current adapted to be associated with said line relays, means for connecting one of said sources with all of the telephone lines to furnish current for the line signaling apparatus, and means when two lines are placed in
120 condition for conversation whereby said first source remains in connection with the calling line through the coils of said line relay, and whereby said second source is connected with the called line through the coils of its
125 line relay, substantially as described.

22. In a telephone system, the combination with a plurality of telephone lines, 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 both coils of said line relay according to whether the line is a calling or a called telephone line, substantially as described.

23. In a telephone system, the combination with a plurality of telephone lines, of a cut-off relay for each of said lines, 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 through the contacts of said cut-off relay, and further means when two lines are placed in condition for conversation whereby one of said lines is disconnected from said source and connected to the other source through the contacts of its cut-off relay, substantially as described.

24. In a telephone system, the combination with a plurality of telephone lines, of a cut-off relay associated with each of said lines, two sources of current for said lines at the central office, means whereby energy from one of said sources is normally maintained on all of said lines through the contacts of its cut-off relay, and further means when two lines are placed in condition for conversation whereby energy from the other of said sources is maintained on one of said lines through the contacts of its cut-off relay, substantially as described.

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

HOWARD M. POST.

Witnesses:

GAZELLE BEDER,
E. A. GARLOCK.