

179. TELEPHONE TRUNKING SYSTEM.
 Divided control.
 Multiple switching.
 Centralized energy.

No. 849,464.

PATENTED APR. 9, 1907.

W. W. DEAN.
 TELEPHONE TRUNKING SYSTEM.
 APPLICATION FILED JULY 24, 1902.

3 SHEETS-SHEET 1.

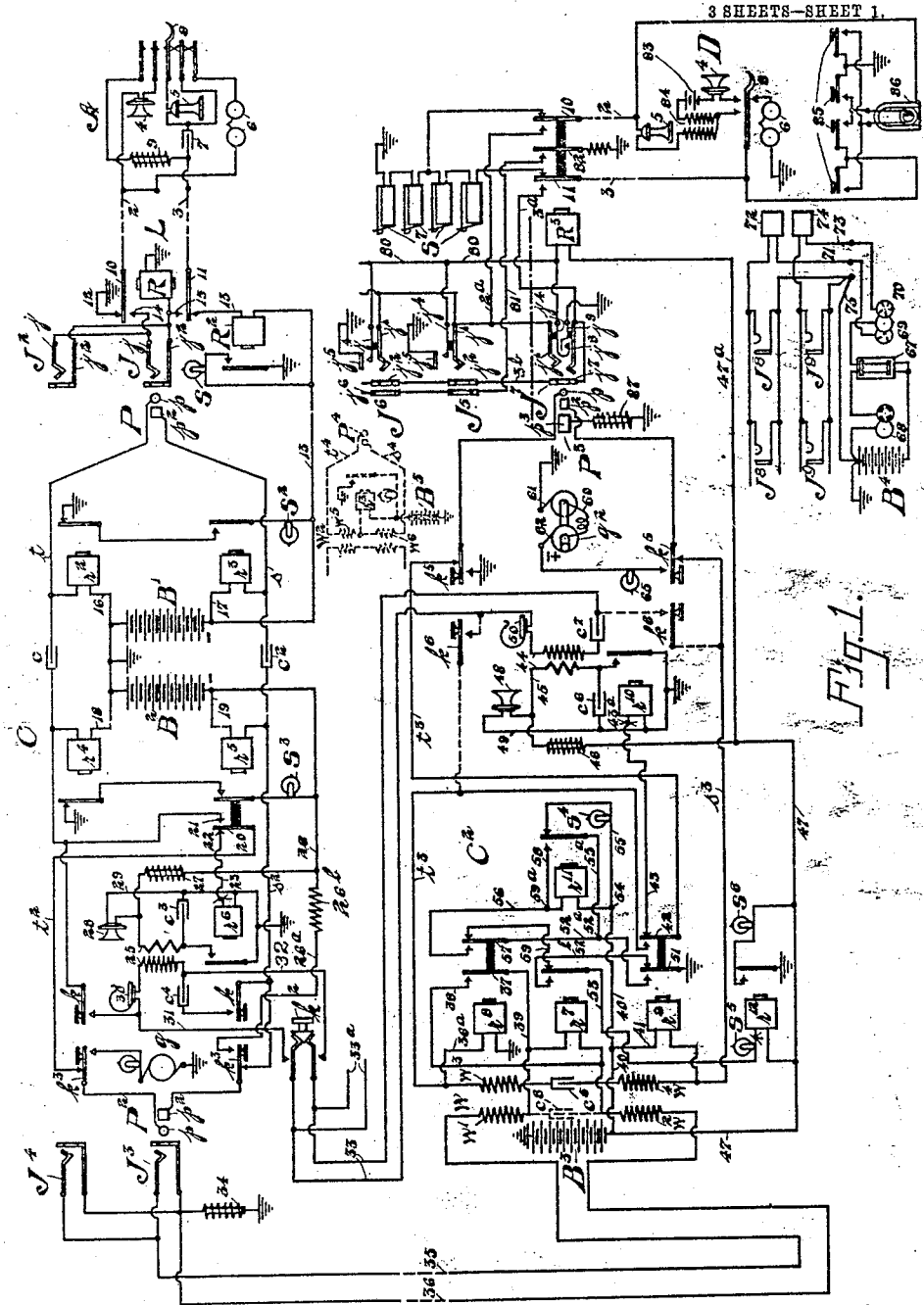


Fig. 1.

Witnesses.
 R. H. Burfield
 F. W. Dinkler

Inventor:-
 William W. Dean,
 by Robert Lewis Ames,
 Attorney.

No. 849,464.

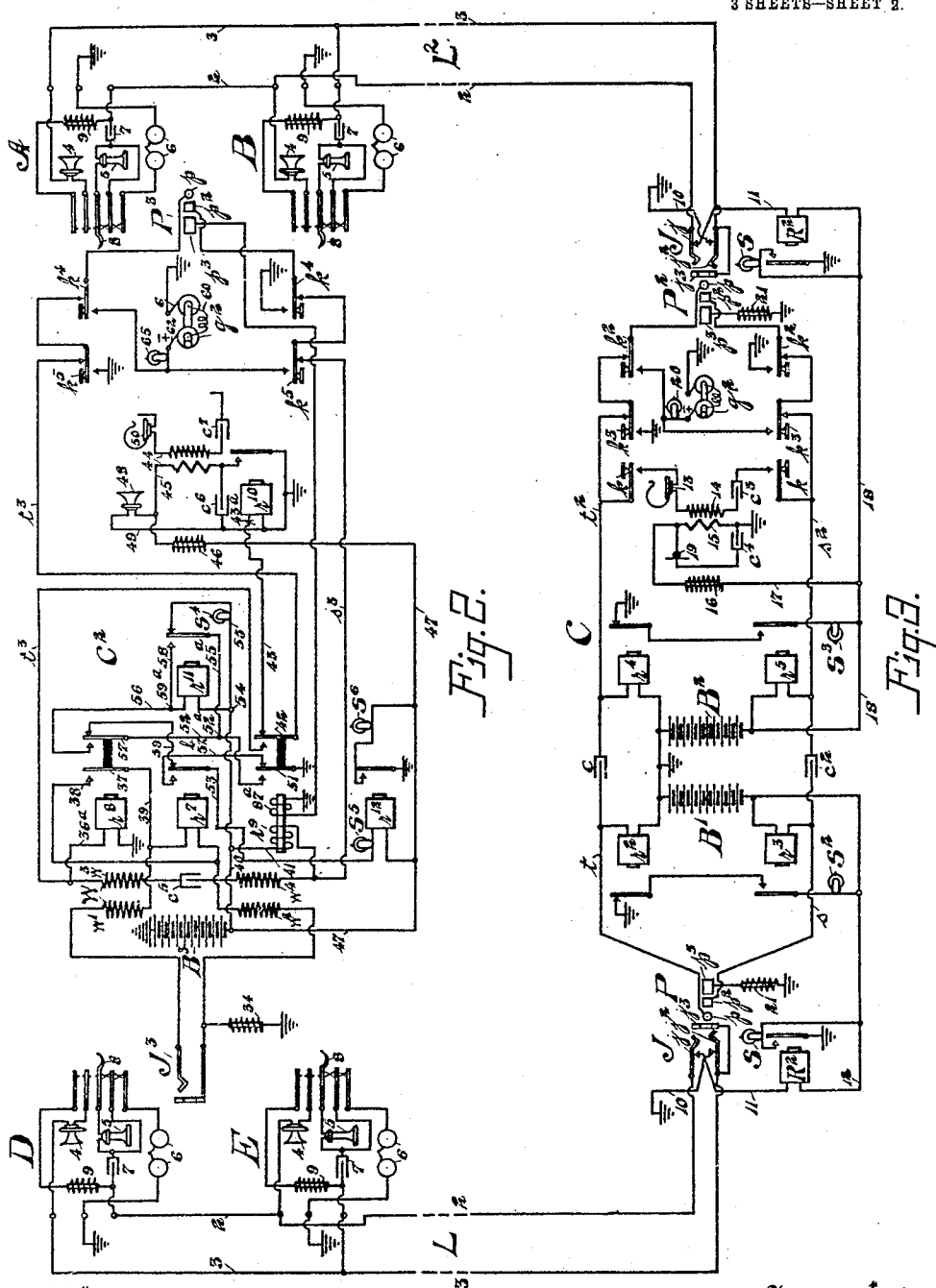
PATENTED APR. 9, 1907.

W. W. DEAN.

TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED JULY 24, 1902.

3 SHEETS-SHEET 2.



Witnesses.

R. H. Burfield
T. D. Dulan

Inventor:-
William W. Dean,
by Robert Lewis Ames,
Attorney.

TELEPHONY.
Systems.
Divided control.
Electric switchboard.
Centralized energy.

Draftsman

No. 849,464.

PATENTED APR. 9, 1907.

W. W. DEAN.
TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED JULY 24, 1902.

3 SHEETS—SHEET 3.

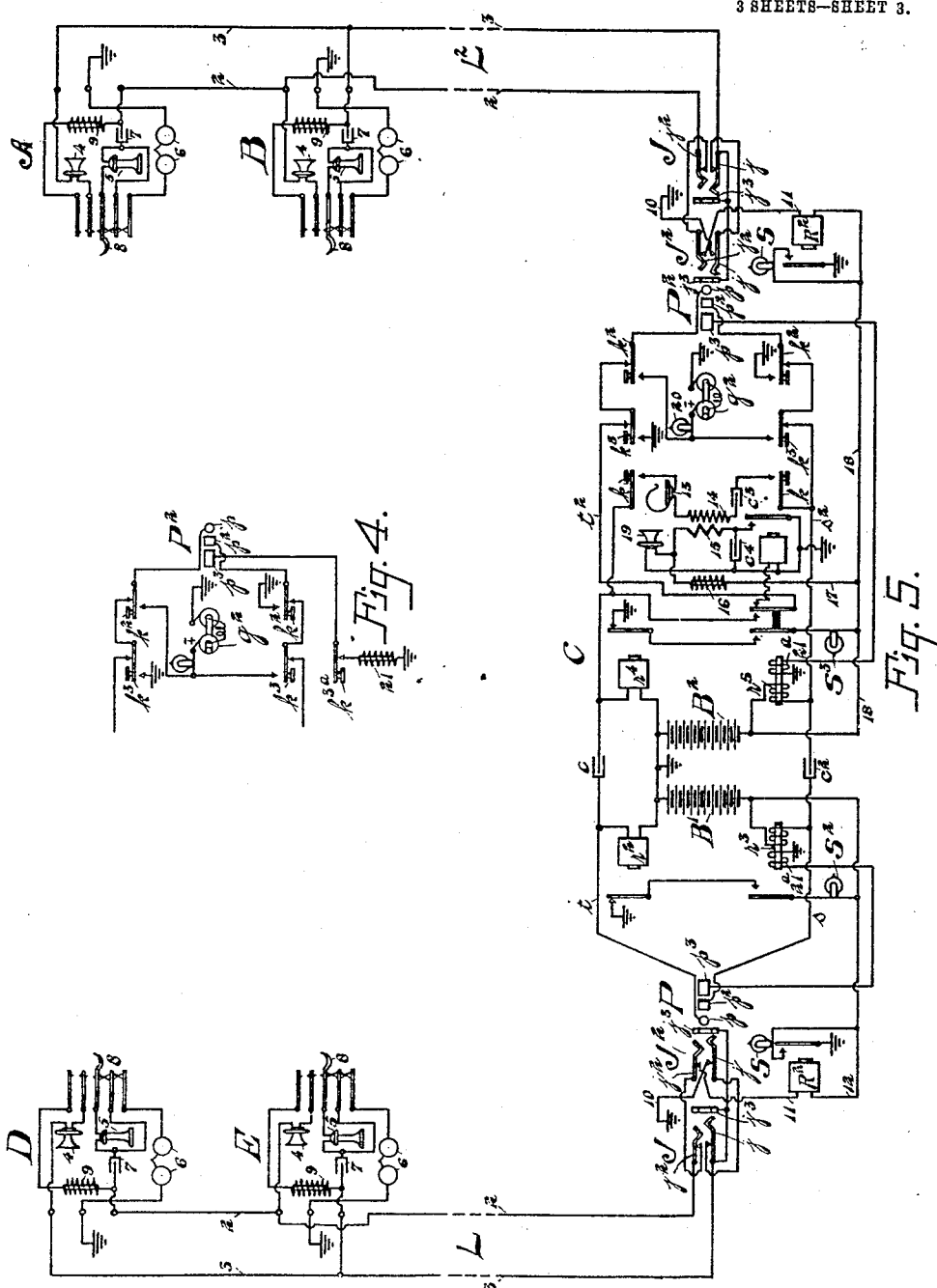


Fig. 4.

Fig. 5.

Witnesses.

R. H. Bentfield
F. W. Duhan

Inventor:-
William W. Dean,
by Robert Lewis Ames,
Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE TRUNKING SYSTEM.

No. 849,464.

Specification of Letters Patent.

Patented April 9, 1907.

Application filed July 24, 1902. Serial No. 116,783.

To all whom it may concern:

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

My invention relates to improvements in telephone systems, and particularly to means whereby subscribers' lines may be readily connected together for conversational purposes.

In an application filed by Francis W. Dunbar, August 23, 1902, Serial No. 120,768, a trunking system is shown adapted to connect subscribers' lines of the "Dunbar" or "two-wire" type terminating at one office with lines of a different type terminating at another office.

My present invention contemplates accomplishing as one of its features a similar result. Subscribers' lines of the Dunbar or two-wire type terminate at the A or originating office, while line-circuits of the "four-wire" type are shown terminating at the incoming or B office. In connection with the latter lines I provide upon the incoming trunk-section of the switchboard an auxiliary jack for each line adapted when connection is made therewith to operate the cut-off relay for the line which is connected in a local circuit, including the normally open contacts of the jack. The jack is also adapted to perform its usual functions in providing a busy testing-contact in order that its busy or idle condition may be determined by the trunk operator. The connecting-plug of the trunk is provided with an auxiliary contact which is connected with a retardation-coil, and means is provided in connection with the jack whereby when the plug is inserted the retardation-coil is connected with the talking-circuit. By this arrangement a suitable path for current over one side of the talking-circuit of the trunk is provided, whereby the trunk is enabled to perform its functions in the usual way.

Another object of the invention is to provide a system in which the subscribers' lines have series contacts in their connecting-jacks in place of cut-off relays and in which the operator's connective means are arranged to establish a connection to ground or the common office return from one side of the talk-

ing-circuit when the said means are connected with the lines for conversational purposes, whereby the supervisory apparatus associated with the connective means is operated in the desired manner.

My invention further contemplates providing a multiple switchboard system of the type employing series contacts in the jacks to arrange the same, together with the operator's connective circuit, so that several operations of testing lines, of ringing the desired subscribers, and suitably supervising the connections for conversational purposes are suitably carried out.

To the accomplishment of these several features and to such others as may hereinafter appear my invention comprises the construction and arrangement hereinafter described, and particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram of subscribers' lines terminating at different central offices, with a cord-circuit at one office and a trunk extending between said offices to connect the lines together for conversation, the lines at the A office having their cut-off relays actuated over a portion of the talking-circuit, while the lines at the latter office have their cut-off relays actuated over the local circuits. Fig. 2 is a diagram of a modified form of trunk. Fig. 3 is a diagram of a system embodying my improvements. Fig. 4 is a diagram of a modification, and Fig. 5 is also a diagram of a different system also employing my systems.

Referring to Fig. 1, L designates one of a plurality of subscribers' lines terminating at the central office C. This line extends in two limbs 2 and 3 from the subscriber's station to the said central office C, where it is fitted with suitable answering and multiple jacks or connection-terminals J J'. At the subscriber's station the usual telephone instruments are provided, comprising a transmitter 4, a receiver 5, a ringer or call-bell 6, and the condenser 7. The switch-hook 8 is adapted in its normal position when the receiver is placed thereon to open the circuit through the transmitter 4 and receiver 5 and to close it through the call-bell 6 and condenser 7. A retardation-coil 9 is connected, when the hook is raised, in parallel with the receiver 5 and condenser 7 to provide a path transparent to

steady currents, but opaque to voice-currents. The line conductors 2 and 3 include, respectively, the armatures or springs 10 and 11 of the cut-off-relay R, which is permanently legged to ground from the sleeve-contacts j^2 j^2 of the jacks J J². The armature or spring 10 is normally connected with ground through the conductor 12, while the opposite armature 11 is normally connected with conductor 13, containing the line-relay R² for the line, said conductor leading to the live or ungrounded pole of the central battery B', the opposite pole of which is grounded. The line-relay R² controls through its armature the circuit of the line-signal S. The forward contacts 14 and 15 of the cut-off relay R are adapted to connect the jacks and the switch-board-section of the line with the external line-circuit when the said cut-off relay is energized.

At the central office C the usual operator's cord-circuit is provided, said cord-circuit having an answering-plug P and a calling-plug P², each being provided with a tip-contact p and a sleeve-contact p^2 , adapted to register with like contact-surfaces j and j^2 in the jacks of the line when the plug is inserted therein. The tip-contacts of the plugs are connected together by means of the tip-strands t and t^2 of the cord-circuit and the interposed condenser c , while the sleeve-contacts are likewise connected by the sleeve-strands s and s^2 and the interposed condenser c^2 . A conductor 16 extends from the grounded pole of the battery B' to the tip-strand t and contains the winding of the tip supervisory relay r^2 , associated with the answering-plug P, while the live pole of the battery is connected by means of conductor 17 with the sleeve-strand s and includes the winding of the sleeve supervisory relay r^3 . These relays r^2 and r^3 serve to control the circuit of the supervisory lamp S², associated with the answering-plug P, the former relay serving to normally close said circuit of the lamp, while the latter relay normally opens the same. The battery B² is associated with the opposite or calling end of the cord-circuit and is connected by conductors 18 and 19 with the tip and sleeve strands t^2 and s^2 , respectively, the former conductor including the winding of the supervisory relay r^4 , while the latter conductor includes the similar relay r^5 . These relays serve in a manner similar to the relays r^2 and r^3 to control the circuit of the supervisory lamp S³, associated with the calling-plug P².

The relays r^2 and r^4 are conveniently referred to as the "tip-relays" and relays r^3 and r^5 as the "sleeve-relays," since they are connected with and operated by current flowing over the corresponding strands of the cord-circuit. The tip-strand t^2 of the calling and testing plug P² is normally open through the extra spring or movable contact 20 of the sleeve-relay r^5 , but is adapted to be closed by

the said spring and its forward contact 21 when the relay is energized. The back contact 22 of this extra spring 20 is connected through the medium of conductor 23 with one side of the high-resistance and high-impedance relay r^6 , known as the "test-relay," the other side of which is grounded. The armature of this relay is likewise grounded, and its forward contact is connected with the primary winding of the operator's induction-coil 25 by means of conductor 24. The other end of the said primary winding is connected through the medium of conductor 26 to the live pole of the battery B², a retardation-coil 27 being included in this circuit. The operator's transmitter 28 is joined on one side to conductor 26, intermediate her primary coil and the coil 27 and on the other side, through conductor 29, to ground. A condenser c^3 is included in the operator's local circuit to facilitate talking and is connected as shown. The secondary winding of her induction-coil 25 is adapted to be included, together with her receiver 30 and a condenser c^3 , in a bridge between the strands of the cord-circuit by means of any suitable key and indicated diagrammatically by k k . Branch connections 31 and 32 lead from opposite sides of the receiver and secondary to an order-key k^2 , connected with an order circuit or wire 33, leading to the office C². A grounded alternating-current ringing-generator g is adapted to be connected through a resistance-lamp with the tip-strand t^2 of the cord-circuit by means of the tip ringing-key spring k^3 , the sleeve-contact k^3 of said key being connected with battery-lead 26 through wire 26^a and resistance 26^b.

A trunk-circuit is shown extending between the central offices C and C², said trunk-circuit being fitted at the outgoing end with multiple jacks J³ and J⁴ and with a retardation-coil 34, legged to ground from the sleeve side of the circuit. The trunk extends in two limbs 35 and 36 to the central office C², where it is provided with suitable means for testing the condition of the wanted line, for ringing the desired subscriber, and with signals to enable the operator to properly attend the connection. The tip and sleeve trunk-conductors 35 and 36 terminate at the incoming office in windings w' and w^2 of the repeating-coil W, and between said windings the trunk-relay r' is connected, said relay being of high resistance. The opposite windings w^3 and w^4 of the repeating-coil W, with an interposed condenser c^5 , are connected between the tip-strand t^3 and the sleeve-strand s^3 of the flexible end of the trunk-circuit, said end being hereinafter referred to as a "trunk-circuit." These strands terminate in the corresponding contacts p and p^2 of the trunk-plug P³. The tip-relay r^8 is legged to ground from the tip-strand t^3 of the trunk-circuit by conductor 36^a and controls

through its spring 37 and forward contact a short circuit composed of conductors 38 and 39 of the high-resistance trunk-relay r^7 . A sleeve-relay r^9 is connected on one side with the live pole of the battery B^3 by means of conductors 40 and 41 and on the other side with the sleeve-strand s^3 . This incoming end of the trunk is provided with a testing apparatus similar to that described for the cord-circuit at the central office C. The forward portion of the tip-strand t^3 is connected with spring 42 of the sleeve-relay r^9 , while the other portion is connected with the forward contact of said spring. The back contact of spring 42 is joined by conductor 43 with the common high-resistance and high-impedance test-relay r^{10} , the opposite terminal of which is grounded. The armature of this test-relay serves when actuated to ground one side of the operator's induction-coil 44, which winding is connected on the opposite side with a conductor 45, containing the resistance and impedance coil 46 and joined to conductor 47, which leads directly to the live pole of the battery B^3 . The operator's transmitter 48 is in a conductor 49, leading from conductor 45 to ground. A condenser c^6 is connected between conductor 49 and the side of the primary that is adapted to be grounded. The operator's receiver 50, together with the secondary of her induction-coil and the condenser c^7 , are connected permanently with the order-circuit 33, leading to the central office C. The conductor 40 leads from battery to the point 54, from which point the branch 55, containing the ringing-lamp S^4 , leads to the back contact of the armature of locking-relay r^{11} , said armature being connected by conductor 55^a to the point 52^a upon the conductor 52, extending between the spring 57 of the tip-relay r^8 and the front contact of spring 51 of sleeve-relay r^9 , the latter spring being grounded, as shown. The conductor 56 extends from point 54 to the front contact of spring 57 of tip-relay r^8 and includes the winding of the locking-relay r^{11} . The forward contact of the armature of this relay is connected to conductor 56 at point 59^a by means of conductor 58. The back contact of spring 57 of tip-relay r^8 is joined by conductor 59 to the back contact of the armature of trunk-relay r^7 , the forward contact of which is connected by conductor 52^b with the back contact of spring 51 of sleeve-relay r^9 . The armature of the trunk-relay r^7 is connected with a conductor 53, leading to the battery-wire 47 and including the guard and disconnect lamp S^5 and the pilot-relay r^{12} , said latter relay serving to control the circuit of the pilot-lamp S^6 .

A ringing-generator g^2 is provided at the incoming end and is connected, by means of the sleeve-contact of the ringing-key k^5 , with the sleeve-strand of the trunk-cord, the op-

posite pole being grounded and the corresponding tip-contact k^5 being also grounded when operated.

The subscribers' lines terminating at this office are of the type known as "four-wire" lines, from the fact that the switchboard-cables comprise four wires, two of them forming portions of the limbs of the metallic telephone-line, a third wire being connected with the insulated and localized test-contacts of the several spring-jacks and the fourth wire to the extra contact or spring in each of the spring-jacks and serving when the plug is inserted in a jack to complete the local circuit of the cut-off relay for the line. The special line shown is also of the four-division type—that is, each line is provided with an annunciator upon four different divisions of the switchboard and with means at the subscriber's station for selectively operating said signals. These signals are indicated by the reference character S^7 and are assumed to be located each upon a different division of the switchboard. An answering-jack is provided for the line upon each of the switchboards and preferably adjacent the corresponding signal S^7 . At one division of the switchboard a number of multiple jacks are provided. These jacks are indicated in the drawings at J^5 and J^6 , a greater number not being shown in order to avoid confusion. The tip-springs j^7 of the jacks are connected together and by means of conductor 2^a with the forward contact of spring 10 of the cut-off relay R^3 , which is connected directly to the limb 2 of the telephone-line.

The sleeve-contacts j^2 of the jacks are connected together by means of conductor 3^b and thence by conductor 3^a to the forward contact of spring 11 of the cut-off relay R^3 , the spring being connected to the limb 3 of the telephone-line. The cut-off relay R^3 for the line is connected, by means of conductors 47^a and 47, with the live pole of the battery B^3 , while its opposite side is connected by conductor 80 to the auxiliary springs j^4 of the jacks J^5 and J^6 , which are adapted when a plug is inserted to be moved into contact with the adjacent grounded plate j^5 , whereby when a connection is established with one of the said jacks the cut-off relay R^3 is actuated. Test-rings j^6 are provided for each of the jacks and are insulated from the remainder of the apparatus and do not engage any contact-surface of a connecting-plug when the latter is inserted in the jack. These test-rings are connected, by means of conductor 81, with the forward contact of spring 82 of the cut-off relay R^3 , which is grounded, whereby when the cut-off relay is actuated the test-rings are connected to ground. At the subscriber's station a local battery 83 is employed for talking, the induction-coil 84 being suitably connected with the line when the receiver 5 is removed from the switch-

hook 8, the latter serving when the receiver is placed thereon to ground the signaling-bell 6 from the sleeve side of the line 3 and to open the connection between the limbs of the line.

The subscriber is provided, as above stated, with means to selectively actuate the signals S^2 , which means comprise the individual keys or push-buttons 85, which, accompanied by the simultaneous operation of the magneto-generator 86, results in actuating the desired signal.

The apparatus so far described is that usually provided for lines of the type mentioned; but at the incoming trunk-section an additional jack J^7 for the line is provided. This jack has its ring-contact j^7 connected with the ring and sleeve-contacts of the other jacks of the line by means of conductor 3^b and is also connected with the conductor 3^a. A tip-spring j^7 is connected with the tip-springs of the other jacks, and a sleeve-spring j^8 corresponds to the sleeve-contacts of the other jacks, the latter being connected directly with the ring j^7 of the jack. An auxiliary spring j^4 is secured to the tip-spring j^7 and similar spring j^9 to the sleeve-spring j^8 , the two springs j^4 and j^9 being brought together upon the separation of the tip and sleeve springs of the jack by the insertion of the plug and when so connected serve to complete the circuit of the cut-off relay R^3 to ground. The tip and sleeve contacts of the plug are adapted to register with the contact-springs j^7 and j^8 of the jack J^7 when inserted therein. An additional contact p^3 is provided for the plug, which is adapted to register with the ring j^7 of the jack in the use of the plug, said contact being connected with the grounded retardation-coil 87. When the plug is inserted, therefore, a retardation-coil 87 is connected, through contacts p^3 and j^7 , the connected spring j^8 , and contact p^2 of the plug, with the sleeve-strand of the trunk-cord.

J^8 J^8 and J^9 J^9 are respectively "busy-back" and "don't-answer" jacks associated with the incoming trunks. These circuits comprise an induction-coil 67, having its primary in circuit with a rapidly-rotating circuit-breaker 68 and the battery B^4 , this battery being preferably the same battery as B^3 , though shown separately for convenience. The secondary of the induction-coil 67 is connected in circuit with the rapid circuit-interrupter 69 and the more slowly operating interrupter 70. From interrupter 69 a conductor 71 leads to the tip-contacts of busy-back jacks J^8 J^8 through a fifty-ohm resistance-coil 72, while interrupter 70 leads by conductor 73 through resistance-coil 74 to the tips of the don't-answer jacks. The sleeves of both sets of jacks are united by conductor 75 with the grounded pole of battery. The circuit-breaker 68 causes induced currents in the secondary circuits, which are interrupted at short intervals by breaker 69

and at longer intervals by breaker 70 to cause distinctive tones at the jacks J^8 and J^9 , whereby when a trunk-plug is inserted in one or the other jacks a corresponding signal is transmitted to the waiting subscriber.

In tracing the circuits hereinafter the plan of pointing out the path for current from the live or ungrounded pole of the battery to the ground only will be followed for convenience, it being understood that the return-current will seek the grounded pole of the battery and that the circuit will therefore be complete.

The operation is as follows: The A subscriber desiring a connection with a subscriber located at another exchange removes his receiver from the hook, and thereby closes a path for current between the limbs 2 and 3 of his line through the transmitter 4 and retardation-coil 9, the condenser 7 and receiver 5 being connected in parallel with the retardation-coil. The closing of this circuit permits current to flow from the battery B' through conductor 13, line-relay R^2 , spring 11 of cut-off relay R , limb 3 of the telephone-line, through the retardation-coil 9 and transmitter 4 at the substation, and thence over limb 2 back to the central office and spring 10 of cut-off relay R through conductor 12 to ground. The line B^2 is thus operated and closes the circuit of the signal-lamp S to ground from the conductor 13. The operator upon seeing the line-signal exposed inserts the answering-plug P into the answering-jack J of the subscriber's line and connects her telephone 30 with the cord-circuit by depressing the listening-key k to receive the order from the subscriber. The insertion of the plug P closes a circuit through the cut-off relay R from the live pole of the battery B' through conductor 17, sleeve supervisory relay r^3 , sleeve-strand s , sleeve-contacts p^2 and j^2 of the plug and jack, thence through the winding of the cut-off relay R to ground. The operation of this relay disconnects the armatures 10 and 11 from the ground-wire 12 and from the battery-lead 13 and connects them through the forward contacts 14 and 15 of said armatures to the normally disconnected jacks J J^2 . The operation of the supervisory relay r^3 over the path just traced serves to close, through its armature and front contact, the circuit of the supervisory signal S^2 , which is associated with the plug P ; but it is prevented from glowing by the operation of the tip supervisory relay r^2 , which is connected in the conductor 16 and receives current over telephone-line and the tip-strand t of the cord-circuit and through the conductor 16 to the grounded pole of the battery B' as soon as the cut-off relay R is operated. The supervisory signal S^2 therefore remains inert while the battery B' furnishes current over the metallic telephone-line for the operation of the supervisory re-

lays and for conversational purposes. The operator's transmitter 28 is receiving current at this time from the battery B^2 over the conductor 26 through retardation-coil 27, thence through the transmitter 28 and over conductor 29 to ground. When sound-waves strike the transmitter 28, the current flowing there-through is varied, which causes a variation of the charge in the condenser C^3 and a corresponding surge of current through the primary of her induction-coil 25. These induce voice-currents in the secondary, which are transmitted to the line, and the operator is therefore able to converse with the calling subscriber.

Upon learning that a subscriber in the exchange C^2 is desired the A operator depresses the order-key k^2 to connect her telephone with the order wire or circuit 33 and repeats the number of the wanted subscriber to the B operator, whose head-telephone 50 is permanently connected with the said order-wire. The latter operator designates to the A operator the trunk to be used for the connection and proceeds to test the condition of the wanted line with the tip of the plug of the incoming trunk named. The cord-circuit used in connection with the lines shown at the incoming office is indicated in dotted lines and comprises a connecting-plug P^4 , the cord-strands t^4 and s^4 terminating in the windings w^5 and w^6 of the repeating-coil W^2 , the middle point of which windings is connected with a supervisory relay r^{13} , the other side of which is connected through the battery B^5 to ground. The opposite end of the cord-circuit is not shown; but it is apparent that in case a cord-circuit is connected with one of the jacks J^5 or J^6 that the sleeve contacts or rings j^2 of the jacks will be connected with the live pole of the battery from the sleeve-strand s^4 of the cord-circuit. When, therefore, the operator at the incoming trunk-section tests the condition of the line by touching the tip of the plug P^3 to the jack of the line a complete testing-circuit is established, a path for current being provided from the live pole of the battery B^5 through the supervisory relay r^{13} , sleeve-strand s^4 of the cord-circuit, sleeve-contacts of the plug P^4 , and the jack J^5 or J^6 , into which the plug is inserted, and over the conductor 3^b to the test-ring j^7 of the jack at the incoming trunk-section. The testing-circuit is then completed over the tip-strand t^3 of the trunk-cord and over conductor 43 through the test-relay r^{10} to ground. The completion of this circuit places ground upon one side of the operator's circuit, which causes a click in her receiver. Owing to the electrostatic capacity of the order-circuit and the operator's apparatus her receiver will respond to this flow of current even though the order-circuit be open at the time at the A exchange. The high-resistance and high-im-

pedance test-relay r^{10} prevents noticeably varying the current upon the line, so that conversation is not disturbed. The test-relay is of course common to all of the trunks at one operator's position, as indicated by 70 the radiating lines 43^a.

In case the line is idle the plug P^3 is inserted in the jack J^7 , with the result that the contacts j^4 and j^9 are brought together, thus operating the cut-off relay R^3 to connect the jacks with the limbs 2 and 3 of the telephone-line, to disconnect the calling-signals S^7 , and to ground the test-rings j^6 of the jacks J^5 and J^6 . The line is thus placed in condition to test "busy" at its other jacks by means of the tip of the plug P^4 , which, as is shown, is connected with the live pole of the battery. At the same time the retardation-coil 87 is connected with the sleeve-strand s^3 of the cord-circuit, which closes a circuit from the live pole of the battery B^3 , over conductors 40 and 41, through sleeve-relay r^9 , and thence over the sleeve-strand s^3 and the retardation-coil to ground. The operation of the sleeve-relay r^9 disconnects the test-relay r^{10} and closes the tip-strand t^3 through the spring 42 and its forward contact for conversation. It also completes the circuit of the ringing-lamp S^4 from the battery B^3 over conductor 40 to the point 54, thence over conductor 55, then through the lamp S^4 to the back contact of the armature of the locking-relay r^{11} , and then by way of conductor 55^a to the point 52^a, and then over conductor 52 to the ground-contact and armature 51 of sleeve-relay r^9 . The ringing-lamp S^4 is therefore operated and indicates to the B operator that the subscriber has not yet responded.

The A operator having received the number of the trunk to be used inserts the calling-plug P^2 of her cord-circuit in the jack J^3 at her section of the trunk designated, this insertion taking place at substantially the same moment that the plug P^3 is connected with the called line. The insertion of the plug P^2 closes a circuit from the live pole of the battery B^2 at the A office through the conductor 19, sleeve supervisory relay r^5 , sleeve-strand s^2 of the cord-circuit, sleeve-contacts of the plug and jack, and through the retardation-coil to ground. This has the effect of positively operating the sleeve supervisory relay r^5 , which attracts its armatures and cuts out the test-relay r^6 , associated with the calling end of the cord-circuit, and completes the tip-strand for conversation. The closing of the tip-strand permits current to flow from the battery B^2 over the sleeve side of the cord-circuit and the trunk-line to the B office and then through the high-resistance trunk-relay r^7 and back to the A office over the tip side of the trunk-line and the tip-strand of the cord-circuit. The closing of this circuit operates the trunk-relay r^7 , which opens, through its armature and

back contact, the circuit of the guard and disconnect lamp S^5 to thereby prevent its operation. As the resistance of the trunk-relay is very high—say twelve thousand or fifteen thousand ohms—sufficient current does not flow in the tip supervisory relay in the A cord to operate the same, whereby the supervisory signal S^3 , associated with said cord, is lighted by current from the battery B^2 and indicates to the A operator that the called subscriber has not yet responded.

Upon insertion of the trunk-plug P^3 the B operator rings the wanted subscriber by depressing key k^5 , which connects the grounded generator g^2 with the sleeve-strand of the cord, thus sending ringing-current out over the sleeve side of the telephone-line and to the grounded signaling-bell 6. In case of the response of the called subscriber while the ringing-current is being sent the ground-contact or the tip-key k^5 provides a path for the return-current. It will be understood that the usual manually-operated ringing-key is employed, which is adapted to simultaneously operate the tip and sleeve contacts from a single lever.

The subscriber having been called responds by taking up his receiver and thereby closes a path for current between the limbs of his line from the main battery B^3 over conductors 40 and 41, sleeve-strand s^3 of the incoming end of the trunk-line 3 of the telephone-line, thence through retardation-coil 9 and transmitter 4 at the substation, thence over limb 2 of the telephone-line back to the central office and over tip-strand t^3 of the incoming end of the trunk, including spring 42 and its forward contact of sleeve-relay r^9 , through conductor 36^a and tip-relay r^8 to ground. This relay responds to this current and closes, through its armature 37 and forward contact, the short circuit of the trunk-relay r^7 . The resistance of the trunk-relay r^7 being now removed from the path of current flowing in the trunk-circuit, the tip-relay r^4 of the A cord receives sufficient current from the battery B^2 to operate the same to thereby open the circuit of supervisory signal-lamp S^3 , thus indicating to the A operator that the wanted subscriber has responded to his call and that the parties are in condition to converse. Although the trunk-relay r^7 is now deenergized and its armature engages its back contact, the guard-lamp S^5 is not operated, because its circuit is opened at the back contact and spring 57 of tip-relay r^8 . The closing of spring 57 of the tip-relay r^8 and its forward contact completes the circuit of the locking-relay r^{11} , as follows: from the live pole of the battery B^3 over conductor 40 to the point 54, thence through the locking-relay r^{11} , over conductor 56 to the forward contact and spring 57 of the relay r^8 , thence over conductor 52 through the forward contact and spring 51 of sleeve-relay r^8 to ground.

The locking-relay r^{11} is therefore operated and opens through its armature and back contact the circuit of the ringing-lamp S^4 , which is extinguished and indicates to the operator that the called subscriber has responded to his ring. The closing of the armature of the locking-relay upon its forward contact completes a locking-circuit for said relay from the point 59^a through conductor 58, the forward contact and the armature of the relay, conductor 55^a to point 52^a, and thence over conductor 52 and the forward contact and spring 51 of sleeve-relay r^9 to ground. This circuit and the relay r^{11} are therefore locked and the ringing-lamp S^4 is also locked out during the remainder of the connection and can only be released when the sleeve-relay r^9 is deenergized, which occurs when the plug P is pulled out.

Should the tip and sleeve contacts of the plug be crossed when the plug is inserted in a jack and the locking and other relays operated, they will be immediately released by the opening of the sleeve-strand in ringing and no confusion would result therefrom. The subscribers are now connected together for conversation and the supervisory signals at both exchanges are extinguished, the battery B' is furnishing current over the answering end of the A cord-circuit to the subscriber's line for talking purposes and for the operation of the supervisory relays, the battery B^2 is furnishing current over the trunk-line for the operation of the supervisory relays associated with the answering end of the A cord-circuit, and the battery B^3 is sending current over the incoming end of the trunk for the operation of the several relays. The voice-currents are transmitted inductively from the subscriber's line L to the trunk-circuit through the condensers c and c^2 in the A cord-circuit and from the trunk-circuit to the incoming end thereof and the subscriber's line connected therewith through the medium of the repeating-coil W . The condenser c^5 between the windings w^3 and w^4 of the repeating-coil at the incoming end of the trunk prevents the flow of steady current therethrough, but permits a free passage of the voice-currents.

At the termination of the conversation the subscribers return their receivers to their hooks, with the result, in the case of the subscriber A, that the tip supervisory relay r^2 , connected with the A cord-circuit, is deenergized and closes, through its armature and back contact, the circuit of the supervisory signal S^2 , thus indicating to the operator that subscriber A has returned his receiver to the hook. When the subscriber D hangs up his telephone, current is cut off from the metallic line in the same way, and the tip-relay r^8 is therefore deenergized. This serves to open the short circuit about the trunk-relay r^7 . The current must flow now through the

trunk-relay r^7 , thus actuating it; but it is insufficient to maintain the tip-relay r^4 in the A cord-circuit in an operated condition, which therefore allows its armature to fall back, closing the circuit of supervisory signal S^3 , which becomes lighted and shows to the A operator that the subscriber D has hung up his receiver. The spring 57 of the tip-relay r^8 at the incoming end of the trunk is now closed to conductor 59, but the trunk-relay r^7 , having operated the circuit of the disconnecting-lamp S^5 , is again opened. The A operator seeing both signals in her cord-circuit exposed withdraws both plugs, thus restoring all parts at her office to normal position. The withdrawal of the plug P^2 at the A exchange deprives the relay r^7 at the incoming end of the trunk of operating-current, which is therefore deenergized, and permits its armature to close upon its back contact, the circuit of the disconnecting-lamp S^5 , and the pilot-relay r^{12} , said circuit being traced from the live pole of the battery B^3 to conductor 47 through the winding of the pilot-relay r^2 and through lamp S^5 , thence over conductor 55, the armature and back contact of trunk-relay r^7 , conductor 59, the back contact and armature 57 of tip-relay r^8 , thence over conductor 52 to the front contact and armature 52 of the sleeve-relay r^9 to ground. The operation of the pilot-relay r^{12} lights the pilot-signal S^6 , which attracts the operator's attention, and who, upon observing the lighted lamp S^5 , is thus informed that the A operator has taken down the connection at that exchange, and she accordingly withdraws the plug P^3 from the jack of the subscriber's line. Upon the withdrawal of the trunk-plug the sleeve-relay r^9 is deenergized and the circuit of the signal-lamp S^5 as well as that of the pilot-relay r^{12} opened at the front contact and armature 51 of the said relay. Both lights S^5 and S^6 are thus extinguished, and at the same time the circuit of the locking-relay r^{11} is broken at the same point, which relay is therefore deenergized and permits its armature to return to normal position.

The disconnecting-signal S^5 serves also as a guard-lamp in case the A operator inserts the calling-plug P^2 into a wrong trunk-jack, for the reason that the trunk-relay of that trunk will be operated while the sleeve-relay r^9 is not operated. A circuit will therefore be completed from the live pole of the battery B^3 over conductor 47, through pilot-relay r^{12} and disconnecting-lamp S^5 , through conductor 53, the armature and front contact of trunk-relay r^7 , conductor 52^b to the back contact of sleeve-relay r^9 , thence through the armature 51 to ground. The disconnecting-lamp B^5 as well as the pilot-lamp S^6 will therefore be lighted and will indicate to the operator that a mistake has been made. At the same time both ringing-lamp S^4 and

guard-lamp S^5 of the trunk whose plug is inserted will operate, thus assuring the operator that the trunk has not been connected with at its opposite end. It will be noticed that the sleeve-relay spring 51 controls, through its forward contact, a ground branch from point 52^a and that from said point two parallel paths are normally completed to the live pole of the battery, one including conductor 55^a, the normal contacts of locking-relay r^{11} , ringing-lamp S^4 , conductors 55 and 40, while the other includes conductor 52, the normal contacts of tip-relay r^8 , conductor 59, the normal contacts of trunk-relay r^7 , conductor 53, including lamp S^5 and pilot-relay r^{12} , and conductor 47 to the battery. When ground is thrown upon these parallel paths, as by the closing of the sleeve-relay r^9 , both lamps are operated. This can only occur under these circumstances, for the reason that in normal working before the subscriber responds both the trunk-relay and the sleeve-relay are operated, the former serving to open one parallel path, which permits only the ringing-lamp to operate. As soon as the subscriber responds the locking-relay operates and holds open the parallel path through its contacts during the remainder of the connection. At the same time, although the trunk-relay is no longer operated, the tip-relay is operated, which again opens the first path, so that lamp S^5 cannot glow. Now when the A operator takes down the connection lamp S^5 operates, but the other parallel path remains open through locking-relay r^{11} .

In case the wanted-subscriber's line is found busy or in case the subscriber having been called does not respond the plug P^3 is inserted in one of the jacks J^8 or J^9 and the corresponding signal is transmitted to the waiting subscriber. Upon inserting the plug P^3 in one of the "busy-back" or "don't-answer" jacks—for example, one of the jacks J^8 —a path for current is provided from the battery B^3 through the sleeve-strand of the trunk-cord, sleeve-contacts of the plug and jack, and over conductor 75 to ground. This will serve to operate the sleeve-relay r^9 to complete the continuity of the tip-strand t^3 of the trunk-cord through its spring 42 and the front contact. Upon the completion of the strand at this point the tip-relay r^8 is provided with current from the live pole of the generator B^4 , through the secondary winding of the induction-coil 67, through circuit-breaker 69, and thence over conductor 71, through resistance 72 and the tip-contacts of the jack and plug, and over the tip-strand and through the relay r^8 to ground. This circuit is interrupted at the breaker 69, so that the relay r^8 is alternately energized and deenergized to correspondingly make and break the short circuit of the trunk-relay r^7 , which is therefore simultaneously removed from and inserted in the circuit of the out-

Switching

Divided control

Multiple switchboard

going and returning energy. This causes the intermittent operation of the tip-relay r^4 in the A cord-circuit to effect the flashing of the supervisory signal S^3 , whereby the A operator is notified that the called-subscriber's line is busy. The flashing of this light of course corresponds to the rapidity of the breaking of the circuit at breaker 67 or 70, which indicates to the operator whether the line is busy or does not answer. The subscriber is also notified by the tone caused in his receiver.

The order-circuit 33, as is indicated by the branching lines 33^a, connects the B operator with several A operators either at the same or at different exchanges. The A operator is also provided with a plurality of keys k^2 to connect herself with the different B operators. The busy-back or don't-answer apparatus is common to the various sections of the incoming trunk-board, as is indicated by the branching lines.

Although I have described the method of making connections through the medium of the order-circuit, I do not wish to so confine the invention, for it is apparent that the A operator is able by means of her testing apparatus to test the condition of the several trunks before her until an idle trunk is found. Upon so testing and finding an idle trunk she may insert the calling-plug P^2 of her cord-circuit, with the result that the trunk-relay r^7 operates and lights the lamp S^5 , which lamp has been previously termed the "guard-lamp;" but in this method of operation it would act as a calling-signal from the A operator to the B operator. The B operator upon seeing the signal S^5 would depress her listening-key k^5 k^6 , which would connect her receiver in series with the repeating-coil windings w^3 and w^4 , these receiver connections being indicated in dotted lines in Fig. 1. She is therefore able to communicate with the A operator. The presence of the condenser c^8 (shown in dotted lines in parallel with the trunk-relay r^7) permits conversation between the operators at this time. Upon learning the desired connection the B operator completes the same, as before described. It will also be understood that had the subscriber A called for a connection with another subscriber in the same exchange the line of that subscriber would have been tested in the ordinary manner by means of the cord-plug P^2 , and the subscriber would have been called by the ringing-generator g .

Fig. 2 shows a modification of the trunk-circuit in which the same parts in general are used as in Fig. 1 and are correspondingly designated, but in which the retardation-coil 87, legged to ground from the third contact P^3 of the trunk-plug, is substituted by winding 87^a upon the core of the sleeve-relay r^9 , whereby the current instead of being wasted by flowing directly to ground assists

the relay r^9 in actuating and retaining its armatures. At the same time the coil acts as the retardation-coil to prevent the passage of voice-currents. This trunk-circuit may of course be used in place of that shown in Fig. 1. A party-ringing device is shown in connection with this trunk-cord, in which the generator g^2 is connected through a suitable resistance-lamp with the sleeve-contact of the ringing-key k^5 and the tip-contact of the ringing-key k^4 , whereby when either key is operated alternating current is sent to the corresponding side of the cord-circuit and telephone-line. Further description of the circuit of this figure in view of that in Fig. 1 is not deemed necessary.

In Fig. 3 I show a cord-circuit provided with a retardation-coil legged to ground from the third contact of the connecting-plug, as in Fig. 1, said cord-circuit being adapted for use in connection with line-circuits of non-multiple type in which series contacts are provided in the jacks in place of cut-off relays and upon which lines the usual subscriber's apparatus is used. The line-circuits L and L^2 which I have shown are of the party-line type—that is, a plurality of subscribers' stations are located thereon. Each of the subscribers' stations is provided with a transmitter 4, adapted to be included with a retardation-coil 9 in series with the line-circuit, and the receiver 5 is removed from the switch-hook 8 during conversation, the condenser 7 being at that time connected in series with the receiver 5, while when the receiver is upon the hook it is in series with the grounded signaling-bell 6. The signaling-bell at one station is connected with the tip side of the line and at the other station with the sleeve side of the line. The subscribers' lines extend in two limbs 2 and 3 to the central office, where they connect directly and respectively with the tip-spring j and the sleeve-spring j^2 of the jack J , the sleeve-ring j^3 of which is directly connected, as shown, with the sleeve-spring j^2 . The spring j^2 is grounded through its normal contact by means of conductor 10, while the tip-spring is connected through its normal contact by means of conductor 11 with the line-relay R^2 , which controls the circuit of the line-signal S and the other side of which is connected by conductor 12 or 18 with the live pole of the battery B' or B^2 . As both lines L and L^2 are exactly alike, the above description will answer for both.

The cord and operator's circuit at the central office is provided with connecting-plugs P P^2 , having their corresponding contacts p and p^2 adapted to register with the tip and sleeve springs of the jack when the plug is inserted therein. The tip-contacts of the plugs are joined by strands t and t^2 and connected together by the interposed condenser c , while the sleeve-strands are likewise joined

by flexible conductors s and s^2 with the interposed condenser c^2 . The battery B' is bridged across the cord-circuit at the answering end and includes the supervisory relays r^2 and r^3 , the former of which is adapted to normally close and the latter to normally open the circuit of the supervisory lamp S^3 , associated with the same plug. The opposite end of the cord-circuit is likewise provided with the battery B^2 and the supervisory relays r^2 and r^5 , controlling in a similar manner the circuit of the supervisory lamp S^3 , associated with the plug P^2 . The operator's receiver 13, the secondary 14 of her induction-coil, together with the condenser c^3 , are bridged across the calling end of the cord-circuit by means of the usual listening-key, indicated in the drawings by the switches k k . The primary 15 of her induction-coil together with a retardation-coil 16 are connected, by means of conductor 17, with a conductor 18, leading to the live pole of the battery B^2 . In shunt of the primary 15 the operator's transmitter 19 and a condenser c^4 are connected, this apparatus being the same as is usually employed for this purpose. An alternating-current generator g^2 is also provided for the plug P^2 and is arranged to be connected between ground and the other side of the cord-circuit through a resistance-lamp 20 by means of the ringing-keys, indicated by the contacts k^2 k^2 and k^3 k^3 , thus actuating the key k^2 to connect the generator g^2 with the tip-strand of the cord, while the sleeve-contact of the said key will be connected to ground while operating the key k^2 to connect the generator between the sleeve-strand of the cord, while the corresponding strand of the cord will be connected to ground.

It will be noticed that the insertion of a connecting-plug into a jack will lift the jack-springs from their normal contacts, and thereby open the circuit of a line-relay R^2 to render the line-signal inoperative. It will further be noticed that the supervisory apparatus associated with the cord-circuit requires that a path for current be established over the sleeve side thereof for the preliminary operation of the supervisory relays r^2 and r^5 . For this purpose the sleeve-springs j^2 of the jacks are directly connected with the sleeve-rings j^3 , and the plugs are provided with third contacts p^3 , which are directly connected to ground through the retardation-coils 21, whereby when a plug is inserted in a jack the sleeve side of the line is grounded through the retardation-coil 21, and a path for current is thereby provided for the sleeve supervisory relays associated with the cord-circuit.

In the operation of the above system let it be assumed that a subscriber on line L wishes to communicate with a subscriber on line L^2 . The receiver at the calling side is removed,

thus completing a circuit between the limbs of the metallic line, which furnishes a path for current from the battery B' through the line-relay R^2 and over the tip side of the line to the calling-substation and thence back to the central office over the sleeve side of the line to ground through conductor 10. The operation of the line-signal causes the operator to insert the answering-plug P of her cord-circuit into the jack of the calling-line, which results in opening the series contacts in the jack to render the line-relay R^2 inoperative, and thereby restores the line-signal S . The retardation-coil 21 is further connected between the ground and the sleeve side of the talking-circuit thus established by means of the third contact p of the plug and ring j^3 of the jack and its permanent connection with the sleeve-spring j^2 , which is now connected with the contact p^2 of the plug and sleeve-strand s of the cord-circuit. A direct path for current from the battery B' through the sleeve supervisory relay r^3 is thus provided, which maintains the same operated as long as the connection exists whether the subscriber's receiver is replaced upon the hook or not. The actuation of the sleeve-relay r^3 serves to close the circuit of the supervisory lamp S^2 , which, however, is prevented from operating by the simultaneous operation of the tip supervisory relay r^2 over the metallic line, owing to the fact that the line-circuit is closed at the calling-substation. The operator then connects her telephone with the cord-circuit in the usual manner, and upon learning that a subscriber in the line L^2 is wanted she inserts the plug P^2 in the jack of that line and depresses the proper ringing-key to selectively call the desired subscriber. The insertion of the plug, it will be noticed, disconnects the line-relay R^2 to prevent the operation of the line-signal S and also completes a path for current over the sleeve-strand of the cord-circuit through the retardation-coil 21, associated with the plug P^2 , to operate the sleeve supervisory relay r^5 , which closes the circuit of the supervisory signal S^3 , lighting it to indicate to the operator that the called subscriber has not yet responded. A path for ringing-current, assuming the ringing-key k^2 to be operated, is grounded through the generator g^2 , the resistance-lamp 20, and the tip-strand of the cord-circuit over the tip side of the line to the substation A and thence through the condenser 7 and grounded signaling-bell 6 to ground, whence it returns by way of the earth to the central office. At the same time the sleeve-spring k^2 is grounded, whereby should the subscriber respond during ringing a path for the return of the ringing-current will be provided. When the called subscriber responds the tip supervisory relay r^4 , associated with the plug P^2 , is operated over the metallic line and renders the supervisory signal S^3

inoperative. The subscribers are now in conversation, and, when through, the return of the receivers to the hooks deenergizes the tip supervisory relays r^2 and r^4 , thus closing the circuit of the supervisory signal-lamps S^2 and S^3 , which become lighted and indicate to the operator that the conversation has terminated. The sleeve supervisory relays remain operated over the paths for current through the retardation-coils 21. The connection is then taken down and all parts are restored to normal position.

Fig. 4 shows an alternative method of arranging the ringing-keys, in which the key that connects the generator between ground and the sleeve is provided with a third contact k^{3a} , which connects the retardation-coil 21 with the sleeve side of the circuit when the ringing-current is being sent out over the line, whereby any loss or leakage of the said current through the coil 21 is prevented.

Fig. 5 indicates a multiple system with series contacts in the jacks, whereby when a connection is established therewith the line signaling device is disconnected, and therefore rendered inoperative. The line-circuits and the substation apparatus are the same as shown in Fig. 3 and are therefore not specifically described with reference to the present figure. Each of the lines, however, is provided with a multiple number of jacks, such as JJ^2 , two only being indicated in the drawing, but as many as desired being employed. The line-limbs are continued through the springs j and j^2 of the several jacks to ground on one side of the line and to the line relay R^2 upon the other. The test-rings j^3 of the jacks are permanently connected together and to the sleeve side of the line. The plugs are provided with third contacts adapted to register with the third contacts j^3 of the jacks and are connected with the winding 21^a , mounted upon the sleeve supervisory relays r^3 and r^5 . These windings constitute the retardation-coils legged to ground from the third contacts of the plugs and assist in actuating the said relays. The operator's circuit is the same as previously described, with the exception that the tip-strand of the cord-circuit is normally severed and its forward portion connected, through the high-resistance and high impedance test-relay r^6 , to ground, this relay being adapted when actuated to ground one side of the operator's circuit to cause a flow of current through the primary thereof, and thereby inductively causing a click in the operator's receiver. When the sleeve supervisory relay operates, the test-relay is disconnected and the tip-strand of the cord-circuit completed for conversation through the forward contact of the spring of the test-relay.

The operation is as follows: A subscriber upon the line L calls in the usual way, thus operating the line-signal S. The operator

inserts the plug P in the answering-jack of the line, thus lifting the tip and sleeve springs from their normal contacts and disconnecting the one limb from ground and the other limb from the line-relay R^2 , thus restoring the line-signal S. At the same time a path for current is provided from the battery B' over the sleeve-strand s of the cord-circuit, sleeve-contact of the inserted plug, sleeve-strand of the jack, and through the connection of the test-ring j^3 of the jack with the sleeve side of the circuit and thence by way of the third contact p^3 of the plug and through the winding 21^a upon the sleeve supervisory relay to ground, thus providing a path for current through the sleeve-relay r^3 , associated with the cord-circuit, and which remains closed until the plug is withdrawn, even though the subscriber should hang up his telephone. At the same time a current from the live pole of the battery B' is impressed upon the test-rings j^3 of the several jacks over the path just described, whereby the line is in condition to test busy at the other multiple jacks. Upon ascertaining the number of the subscriber wanted the line is tested by means of the connecting-plug P^2 . As explained above, if the line is busy the test-rings are connected with the live pole of battery, whereby when the tip of the plug touches the test-ring a complete path for current is provided through the forward portion of the tip-strand of the cord-circuit and through the test-relay r^6 to ground. Owing to the high resistance and high impedance of this test-relay, the current change upon the line is not sufficient to disturb the connected subscribers. If the line is idle, a plug is inserted, with the result that the line-relay R^2 is disconnected from the line to prevent the operation of the line-signal, and the sleeve supervisory relay r^5 is actuated over the path completed through the third contacts of the plug and jack. The actuation of this relay disconnects the test-relay and places the tip-strand of the cord in condition for conversation. The supervisory signal S^3 , associated with said plug, is also actuated, and after the subscriber has been called in the usual way and has responded to his call the tip supervisory relay is actuated by current over the metallic line and the supervisory signal is rendered inert. At the termination of the conversation when the subscribers return their receivers to the hooks the supervisory signals are lighted in the usual manner and the connection is taken down and all parts restored to normal position.

The ground connections hereinbefore referred to at the several substations, it will be understood, may and in practice usually are one and the same, or they may be the common office return, although it is found by experience that it is better to place a dead

ground upon one side of the common battery. It is also apparent that the other poles of the batteries may be grounded so far as the operation of the system is concerned, the only variation necessary from that shown in the drawings being to remove the present ground connections and replace them by other conductors and to substitute a ground for the opposite pole of the battery.

It will also be understood that modifications of the several figures may be used interchangeably in the system.

While I have described several forms of my invention and several different ways of carrying the same into effect, I do not wish to be limited to the precise methods, as it is apparent that various other changes and substitutions may be made and still come within the scope and principle of my invention; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. The combination with a connecting-plug adapted to be connected with a telephone-line to establish a conversational circuit therewith, of a pair of main line-contacts on said plug adapted to be included in the opposite sides of the metallic talking-circuit when connection is established, a third contact on said plug, and a suitable conductor connected therewith adapted to be brought into metallic connection with one of said main contacts when the connection is established, and a retardation-coil individual to the plug connected between said third contact and said suitable conductor, and telephone apparatus affected by current over said latter path, substantially as described.

2. The combination with a connecting-plug adapted to be connected with a telephone-line to establish a conversational circuit therewith, of a pair of main line-contacts on said plug insulated from each other and adapted to be included in the opposite sides of the metallic talking-circuit, a third contact on said plug insulated from the other contacts and adapted to be brought into engagement with one of said contacts when the talking-circuit is established, and a retardation-coil associated individually with said plug and legged to ground from said third contact and telephonic apparatus affected by current through said coil, substantially as described.

3. The combination with a telephone-line, of a cord and plug adapted to be connected therewith, a source of current connected with a talking-strand of said cord, a retardation-coil connected with said plug and normally insulated from the talking-strand, means for connecting said retardation-coil and source in a complete circuit including said talking-strand when the plug is connected with the line, and apparatus associated with the cord

and plug actuated by current in said complete circuit, substantially as described.

4. The combination with a telephone-line, of a cord and plug adapted to be connected therewith, a source of current connected with a talking-strand of said cord, a retardation-coil connected with said plug and normally insulated from the talking-strand, means for connecting said retardation-coil and source in a complete circuit including said talking-strand when the plug is connected with the line, and supervisory apparatus associated with said cord and plug and actuated over said complete circuit, substantially as described.

5. The combination with a telephone-line, of a cord and plug to establish connections therewith, a signal for the cord-circuit, a relay associated with the cord and plug and adapted to be actuated over one strand of the cord-circuit to affect said signal when a connection is established, an auxiliary contact on the plug, a suitable conductor to which said contact is connected, a retardation-coil connected between said contact and said suitable conductor, and a jack of the line having contacts to register with the talking-contacts of the plug and the auxiliary contact, the latter contact being connected with a talking-contact when the connection exists, whereby a path for current over said strand through said retardation-coil is provided upon the insertion of the plug, substantially as described.

6. The combination with a telephone-line of a cord and plug to establish connections therewith, a supervisory relay associated with the cord and plug and adapted to be actuated over one strand of the cord-circuit when a connection is established, an auxiliary contact on the plug, a suitable conductor to which said contact is connected, a retardation-coil connected between said contact and said suitable conductor, and a jack of the line having contacts to register with the talking-contacts of the plug and the auxiliary contact, the latter contact being connected with a talking-contact when the connection exists, whereby a path for current over said strand through said retardation-coil is provided upon the insertion of the plug, substantially as described.

7. In a telephone system, the combination with telephone-lines having connection-terminals, of an operator's connective circuit provided with a plug adapted to be connected with said terminals to establish conversational circuits with the lines, a source of current associated with the cord-circuit and connected to one side thereof, telephonic apparatus associated with the cord-circuit and adapted to be operated by current from said source over said side of the cord-circuit, a normally insulated contact on said plug and

a connection therefrom to the other pole of said source, and means whereby when the plug is connected with one of said terminals the path for current is completed from said
5 contact to the said side of the cord-circuit and through said apparatus, substantially as described.

8. In a telephone system, the combination with a telephone-line, of a cord-circuit for
10 establishing connections therewith, a supervisory signal for said cord-circuit, and a relay to control said signal, said cord-circuit having a connecting-plug, a connection from

ground through a retardation-coil to one contact of said plug, whereby a path for current is provided which allows steady currents to pass to actuate said relay during connection, but which obstructs the voice-currents, substantially as described.

Signed by me at Chicago, county of Cook, 20 State of Illinois, this 22d day of July, 1902.

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,
GAZELLE BEDER.