

No. 853,682.

PATENTED MAY 14, 1907.

W. W. DEAN.
TELEPHONE TRUNKING SYSTEM.
APPLICATION FILED JUNE 28, 1902.

3 SHEETS—SHEET 1.

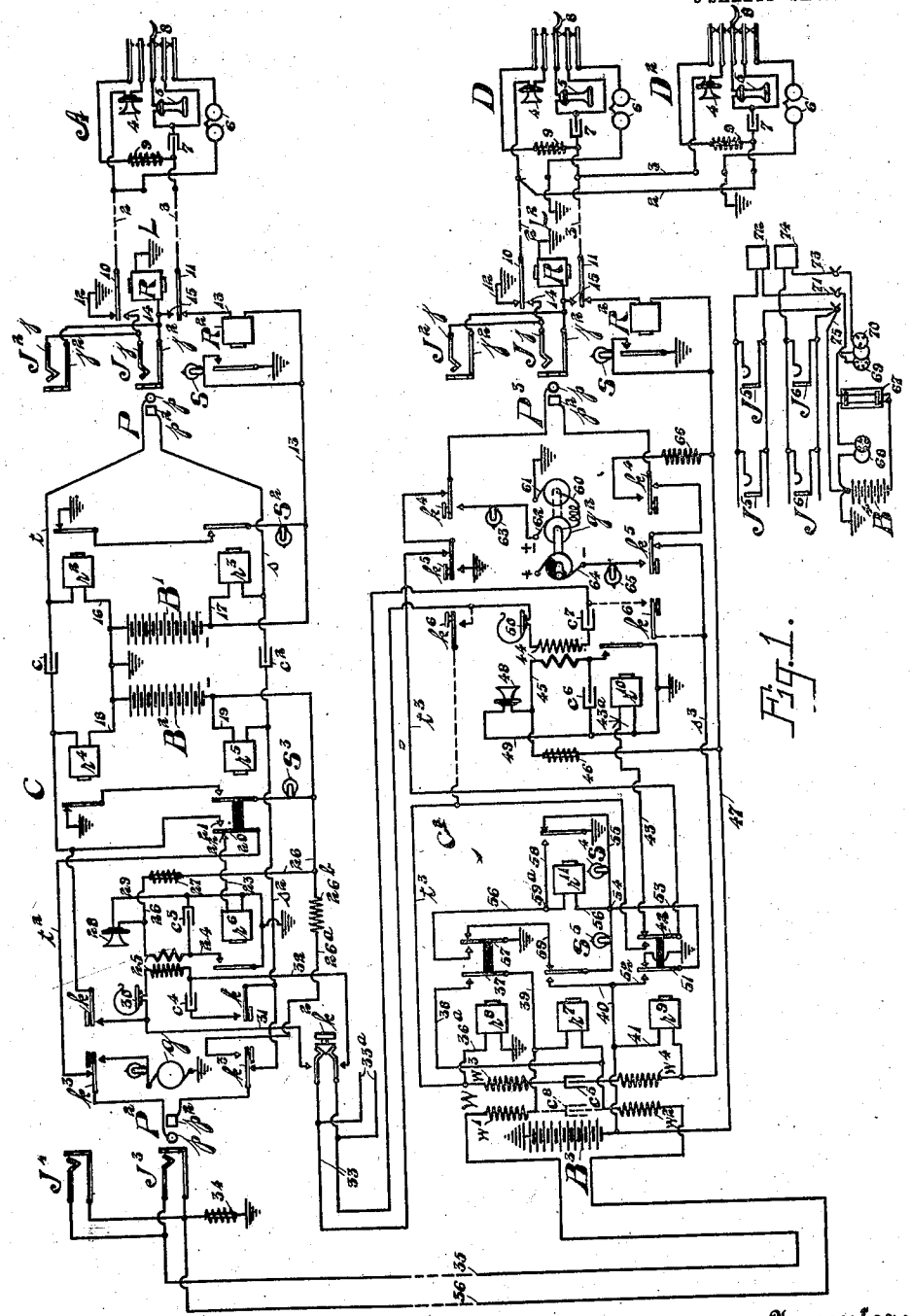


Fig. 1.

Witnesses.
R. H. Bird
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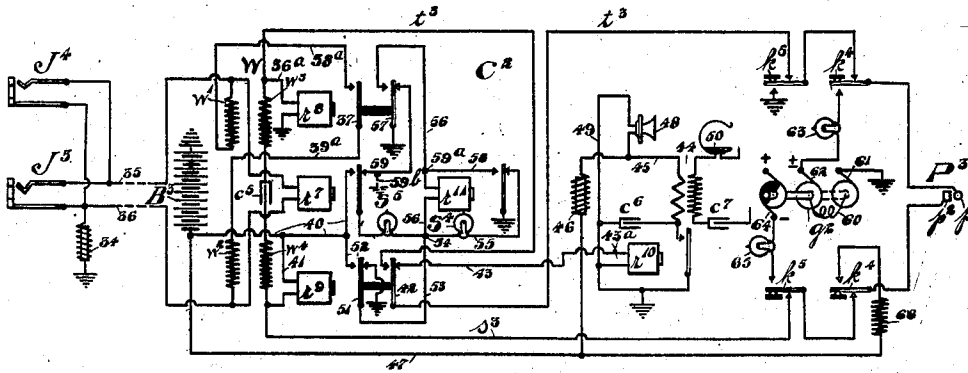


Fig. 2.

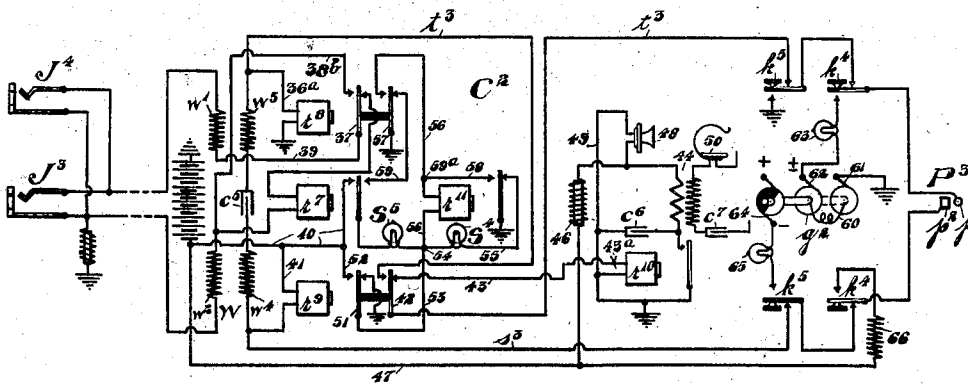


Fig. 3.

Witnesses.

R. L. Bonfines
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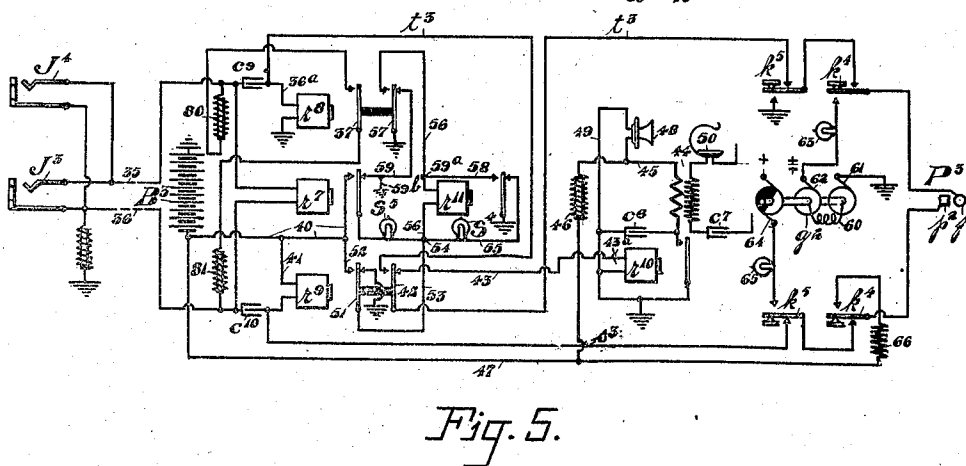
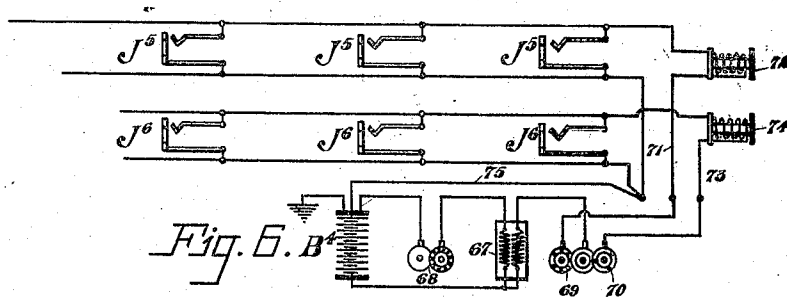
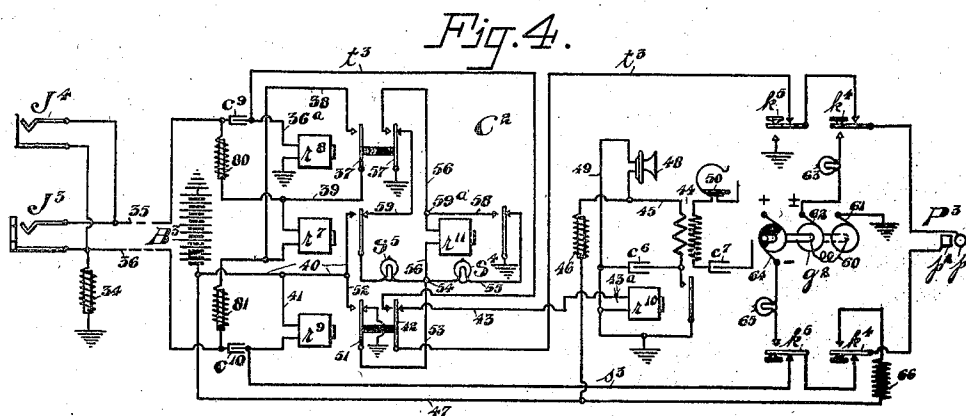
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3 SHEETS—SHEET 3.



Witnesses.
R. H. Burdett
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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. 853,682.

Specification of Letters Patent.

Patented May 14, 1907.

Application filed June 28, 1902. Serial No. 113,581.

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 and State of Illinois, have invented new and useful Improvements in Telephone Trunking Systems, of which the following is a specification.

My invention relates primarily to telephone trunk circuits and apparatus co-operating therewith, whereby telephone subscribers whose lines terminate at different central offices or central stations may be connected together for conversational purposes.

In common battery telephone systems there are two distinct and well defined types of circuits employed. In both types the subscriber's lines are each provided at the central office with a line signal controlling electro-magnet and a connection to the common battery, whereby when a subscriber desires to call the central office, he closes the limbs of his line together at his station, preferably by taking up his receiver, thus completing the circuit of the battery through said electro-magnet to operate the same and indicate a call. The limbs of the line are also carried through the normally closed contacts of a relay, known as the "cut-off relay," at the central station, which relay when operated serves to open the line to the said electro-magnet and battery to render the line signal inoperative. In one type of circuits the winding of this cut-off relay is entirely free from and unconnected with the line circuit, and since it is desired to operate the said relay only during a connection with the line for conversational purposes, the said winding is included in a local circuit which is adapted to be closed in registering contacts of the line jack or connection terminal and the plug of the operator's cord circuit, when the plug is inserted in the jack to establish a connection with the line. As the cut-off relay must be capable of operation from any section of a multiple switchboard these extra contacts in the several jacks are connected together. These contacts with their connections are entirely isolated from the line circuit proper and are made use of for testing to determine the busy or idle condition of the line, since they are connected directly with battery during an established connection through the medium of a third strand in the cord circuit. The

supervisory signal associated with each end of the cord circuit is usually included in this third strand and is shunted during connection by a relay in one of the main strands of the cord circuit. This arrangement of circuits, it is apparent, requires a third wire throughout the switchboard for every line, a third contact or point in every jack, a third contact for every connecting plug and a third strand in every cord circuit. It is this characteristic that has given rise to the popular yet expressive terms "three wire systems," "three-point jacks and plugs," and "three strand cord circuits" to denote systems and apparatus of this type.

The second and other distinctive type of systems referred to, is that in which the cut-off relay is connected with the line and is operated over a portion of the talking circuit, as distinct from a local circuit independent of the line, whereby the circuit of said relay is closed through one of the main line terminals of the line jacks when the plug is inserted in the jack. With this arrangement it is seen that but "two point jacks" are required for the lines and but two cables or wires extend throughout the switchboard; the plug will have two contacts and the cord circuit may be reduced to two strands. The supervisory signals are also actuated by current flowing over a portion of the talking circuit and rendered inoperative by current over the telephone line when the subscriber responds. In this system, moreover, the busy testing is accomplished on one of the main line terminals of the jacks. A radically different principle of operation is therefore involved in this so-called "two-wire" or "Dunbar system" from that of the three-wire system, so far as the operation of the cut-off and supervisory relays and the busy testing is concerned. One practical advantage of the latter type of system is that a single switchboard may have a capacity of 24,000 or more telephone lines owing to the small plugs and jacks that may be used, while with the three point jacks and plugs the capacity of the board is limited to a far less number of lines. A second great advantage is the decreased amount of copper wire used in and about the switchboard, the cheapening of the manufacture of the apparatus, and the reduction in the cost of installation.

and repairs. It is necessary, however, in all systems to provide trunk circuits between exchanges in order that the different subscribers whose lines terminate thereat can freely communicate. Such circuits have already been devised and patented for the three wire systems, but so far as I am aware, I am the first to provide a practically and commercially successful trunking system for use between exchanges of the two wire or Dunbar type of circuits; and it is to this subject matter that my present invention primarily relates, my main object being to provide a trunking system that is adapted for use with two wire circuits and apparatus, and in which the whole operation of establishing and supervising trunking connections between exchanges is carried out in the best, most satisfactory and approved manner.

The central office at which the call for a connection originates is known in telephonic parlance as the "A" or "outgoing" office and the trunks so used, as the "outgoing" trunks, while the office at which the connection is completed is known as the "B" or "incoming" office and the trunks as "incoming" trunks. These terms are used hereinafter with this meaning.

In accordance with my invention the A operator answers the call of a subscriber for a connection in the regular manner, and upon finding that a subscriber is wanted in an other exchange she connects her telephone with the order wire or circuit extending to the B operator at that exchange and orders the desired connection. The B operator designates to the A operator the trunk to be used and at the same time tests the wanted line with the tip of the same incoming trunk plug. The test is automatic, that is, the B operator is not required to cut in with a listening key in order to make the test, it being merely necessary to touch the tip of the plug to the jack ring. Upon finding the line idle the plug is inserted and the ringing key operated to call the wanted subscriber. The A operator inserts the plug of her cord circuit in the jack of the trunk designated as soon as she is notified by the B operator. When the B operator has plugged into the wanted line the supervisory lamp in the calling side of the A operator's cord circuit lights and remains lighted until the subscriber responds to his call. A ringing lamp at the B or incoming end of the trunk also lights and remains lighted until the subscriber responds. When the subscriber responds the ringing lamp at the B operator's position is extinguished and is locked out so that it cannot again light during the connection, not even when the subscriber hangs up his receiver. The supervisory lamp in the A operator's cord circuit is also extinguished as soon as the subscriber responds as stated, and again lights when the subscriber replaces his telephone upon the

hook. The A operator is thus charged with supervising the connection after the plugs are up, and receives the disconnecting signal directly from both subscribers. The B operator receives a disconnecting signal only when the A operator has taken down the connection at her office. At this time the disconnecting lamp at the B end of the trunk is lighted. The disconnecting lamp at the B operator's position preferably operates also as a guard lamp, that is, as a lamp to indicate when a mistake has been made, as, when the A operator inserts the plug into a wrong jack. A "busy-back" and "don't answer" circuit is provided in connection with the incoming trunks whereby when the desired subscriber is busy or does not answer, the incoming trunk plug may be inserted in the proper jack from which a corresponding signal is sent to the waiting subscriber to inform him of the condition of the wanted line. In order to carry out these various operations I provide in connection with the incoming ends of the trunks four relays and in addition thereto a test relay which is preferably common to all of the trunks at one position. These relays may be designated as the tip relay, which is legged to ground from the tip side of the circuit; the sleeve relay, legged from the sleeve side of the circuit through battery to ground; the trunk relay, which is connected to the outgoing side of the incoming trunk circuit and which is preferably of high resistance, and the locking relay, which serves when operated to lock out the ringing lamp during the connection.

The invention also consists of the various combinations hereinafter described and particularly pointed out in the appended claims.

My invention is illustrated in the accompanying drawing, in which the same reference characters designate like parts throughout the several views, and in which

Figure 1 is a diagram showing the subscribers' lines leading to two different central offices and the trunking connections between said central offices to enable the subscribers to be connected for conversation; Fig. 2 is a diagram of a modified form of trunk; Fig. 3 is a similar diagram of a modification in the trunk between two stations; Figs. 4 and 5 are also modifications of trunk circuits; and Fig. 6 is a diagram of the "busy back" and "don't answer" circuits.

Referring to Fig. 1, L designates one of the plurality of subscribers' lines terminating at the central office C. This line extends in two limbs 2 and 3 from the subscriber's station A 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, and consists of 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 and 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 at the substation 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^3 , of the jacks J, J^2 . 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 R^2 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 R^2 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 switchboard section of the line with the external line circuit when the said cut-off relay is energized. This, it is to be understood, is a typical two-wire line circuit and is the particular kind with which I prefer to use my trunk circuits, although I do not wish to so limit the use of the invention in all respects.

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 answering 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^4 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 C'. 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^5 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 C', said trunk circuit being fitted at the outgoing end with multiple jacks such as J³ and J⁴, or any number, and with a retardation coil 34 connected to ground from the sleeve side of the circuit. The trunk extends in two limbs 35 and 36 to the central office C' 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 the windings w' and w'' of the repeating coil W, and

between said windings the trunk relay r^7 is connected, said relay being of high resistance. The opposite windings w^3 and w^4 of the repeating coil W are connected with an interposed condenser c^5 between the tip strand t^3 and the sleeve strand s^3 of the flexible end of the trunk circuit, which strands terminate in the corresponding contacts p and p^3 of the trunk connecting plug P^3 . A 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 circuit 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 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 primary winding of the operator's induction coil 44, which winding is connected on the other side with a conductor 45 containing the resistance and impedance coil 46 and joined to conductor 47 leading 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 condenser c^7 are connected permanently with the order circuit or wire 33 leading to the central office C . The forward contact of spring 51 of sleeve relay r^9 , is connected by conductor 52 with the conductor 40 leading from the live pole of generator B^3 . The spring 51, which is normally grounded, is connected by conductor 53 leading to point 54, and thence by conductor 55 through the ringing lamp S^4 to the normal contact of the grounded armature of locking relay r^{11} . The locking relay r^{11} is connected in a conductor 56 extending from point 54 to the forward contact of grounded spring 57 of tip relay r^8 . The forward contact of the locking relay armature is joined by conductor 58 with conductor 56 at point 59^a. The guard and disconnecting lamp S^5 is connected between the point 54 and the armature of trunk relay r^7 , the back contact of which is joined by branch 59 to the back contact of spring 57 of tip relay r^8 . The forward contact of the trunk relay r^7 is

connected by conductor 40 with the live pole of the battery B^3 . This incoming end of the trunk is equipped for selectively ringing subscribers upon a party line. It comprises the ringing key contacts k^4 , k^4 , and k^5 , k^5 , placed in the strands of the trunk cord and adapted when actuated to suitably connect the alternating current generator g^2 with the plug P^3 . This ringing generator comprises the armature 60, the grounded brush 61, the brush 62 from which the alternating current is directed through resistance lamp 63 to tip key spring k^4 , when depressed, and brush 64 from the split commutator ring which is adapted to deliver a current of negative pulsations only through lamp 65 to the sleeve key k^5 when the key is operated. The sleeve contact of key k^4 when operated connects the sleeve of the plug to battery lead 47 through resistance coil 66 to maintain the cut-off relay of the line operated during ringing. The subscriber's line shown in connection with this office is of the "party line" type and is connected to subscribers D and D^2 . The apparatus at these stations is similar to that at the station A , and are likewise indicated, except that the bell 6 at station D is connected between the sleeve conductor 3 and ground, while at station D^2 the bell is connected between the tip conductor 2 and ground. The same type of normally disconnected jacks, J , J^2 , line relay, R^2 , cut-off relay R^1 , and the line signals S are employed and are designated by the same reference characters. The battery B^3 furnishes current for the operation of these various relays, and signals, as well as for talking.

J^3 , J^5 , and J^6 are respectively "busy back" and "don't answer" jacks associated with the incoming trunks. These circuits are shown more clearly in Fig. 6, and 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^5 , J^5 , through a 50 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 the 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^3 and J^6 , whereby when a trunk plug is inserted in one or the other jack a corresponding signal is transmitted to the waiting subscriber.

In tracing the circuits hereinafter, the plan for 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 R², spring 11 of cut-off relay R, limb 3 of the telephone line, through retardation coil 9 and transmitter 4 at the sub station, 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 relay R² 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*, *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 r³, sleeve strand s, sleeve contacts p² and j² 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, J². The operation of the supervisory relay r³ over the path just traced serves to close through its armature and front contact the circuit of the supervisory signal S² which is associated with the plug P, but it is prevented from glowing, by the operation of the tip supervisory relay r² which is connected in the conductor 16 and receives current over telephone line and the tip strand 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 S² therefore remains inert while the battery B' furnishes current over the metallic telephone line for the operation of the supervisory relays and for conversational purposes. The operator's transmitter 28 is receiving current at this time from the battery B² over the conductor 26 through retardation coil 27, thence through the trans-

mitter 28 and over conductor 29 to ground. When sound waves strike the transmitter 28, the current flowing therethrough is varied which causes a variation of the charge in the condenser c³ 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 C² is desired, the A operator depresses the order key k² 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. If the line is idle no "click" will be received, but if busy the sleeve contacts of the jacks of the line will be connected with the live pole of a battery through the sleeve contact and strand of the inserted plug. A complete circuit will therefore be established from the sleeve contact of the tested jack, which it is assumed is connected with the live pole of the battery, through the tip of the plug P³, tip strand t³, spring 42 and back contact of sleeve relay r⁴ conductor 43 through the common high resistance and impedance test relay or responsive device r¹⁰ to ground. This test relay will therefore operate and ground through its armature and front contact one side of the primary of the operator's induction coil 44, the other side of which is connected by conductor 45 through resistance 46 and conductor 47 to the live pole of the battery B³. The completion of this circuit will permit a flow of current therethrough which will induce a current in the secondary of the said induction coil and produce a click in the receiver 50 of the operator's set. The operator's receiver will respond to this click at all times even though the order circuit should be open at the A exchange since the electro-static capacity of her circuits and that of the order circuit is ample for the purpose of producing the click.

In the three wire systems where the test circuits are insulated from the subscriber's line there is no danger of varying the current flowing in the line to the annoyance of the subscriber during testing. But in the two wire systems where the testing contacts are connected directly with the talking circuit some means is necessary or at least desirable to prevent noticeably varying the current upon lines connected for conversation when testing their condition at other sections of the switchboard. This is accomplished in the circuit described by means of the test relay

r^{10} which is of such high resistance as to vary the current upon the tested line but slightly and which is also of high impedance so that its current will build up slowly to thereby prevent a sudden variation of current on the line. The subscriber or subscribers whose lines are tested are therefore undisturbed by a sudden or large variation of current through their instruments. It is apparent that any other suitable test responsive device or indicator than the relay 10 can be employed and that the operator's telephone can be used in place of the same or in the circuit with a retardation coil, but the arrangement described is preferred. This relay is preferably common to all the incoming trunks at one operator's position as indicated by the branching lines at 43^a. Upon finding the line idle the plug P^3 is inserted in one of the multiple jacks of the wanted subscriber's line.

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. The insertion of the plug P^2 closes a circuit from the live pole of the battery B^2 at the A office, through conductor 19, sleeve supervisory relay r^5 , sleeve strand s^3 of the cord circuit, sleeve contacts of the plug and jack and through retardation coil 34 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 and completes the tip strand of the cord circuit through armature 20 and its forward contact 21. The closing of this tip strand permits current to flow from the battery B^2 over the sleeve strand of the cord circuit the sleeve conductor 36 of the trunk line through the winding w^2 of the repeating coil W at the B exchange, through trunk relay r^7 and thence through repeating coil winding w' and over the tip conductor 35 of the trunk back to the A exchange and thence over tip strand t^2 of the cord circuit and through conductor 18 containing the winding of tip supervisory relay r^4 to the opposite pole of the battery B^2 . The closing of this circuit operates the trunk relay r^7 , but as the resistance of this relay is very high, sufficient current does not flow through the tip supervisory relay r^4 at the A exchange to operate the same. The supervisory signal S^3 associated with the calling plug P^2 of the A cord circuit is therefore lighted by current flowing from the live pole of the battery B^2 through conductor 26, the signal lamp S^3 , the armature and forward contact of sleeve supervisory relay r^5 and thence through the armature and back contact of tip supervisory relay r^4 to ground. This lamp is therefore lighted and remains lighted as hereinafter explained until the response of the called subscriber at the B exchange.

The insertion of the incoming trunk plug

into the jack of the wanted line, 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 of the flexible end of the trunk through the sleeve contacts of the plug P^3 and the jack of the called subscriber and thence to the cut-off relay R of the wanted line to ground, thus operating both the sleeve relay r^9 and the cut-off relay R , the latter serving to disconnect the line relay R^2 of the line to render the line signal inoperative and to connect the normally disconnected jacks with the limbs of the line extending to the sub stations. The operation of 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 and thereby establishes the circuit for conversation. It also completes the circuit of the ringing lamp S^4 from the battery B^3 over conductor 40, conductor 52, the forward contact and spring 51 of the sleeve relay, conductor 53 to point 54 and thence through the ringing lamp S^4 over conductor 55 through the back contact and armature of locking relay r^{11} to ground. This lamp is therefore lighted and indicates to the operator that the called subscriber has not removed his telephone from its hook. The operation of the trunk relay r^7 at this time opens through its armature and back contact the circuit of the guard and disconnecting lamp S^6 to thereby prevent its operation. Upon the insertion of the trunk plug P^3 the B operator rings the wanted subscriber. If the subscriber D is the one desired, the ringing key k^3 , k^5 is depressed which throws ringing current upon the sleeve strand connected with the plug P^3 and operates the subscriber's bell over the following path: from ground at the generator g^2 , brush 61, armature 60 of the generator, brush 64 through resistance lamp 65, key k^5 , thence over the sleeve strand of the cord to the plug P^3 over the sleeve limb 3 of the telephone line to the station D and thence through condenser 7 and bell 6 to ground; the receiver 5 being at this time upon the hook 8 and therefore completing the circuit between the condenser 7 and bell 6. It will be noticed that just previous to the depression of the ringing key k^5 the cut-off relay R was receiving a negative current through its coils from the battery B^3 . At the instant the ringing key k^5 is depressed this path of current from the battery B^3 is broken, but a new path is immediately established through the relay R from the negative source of pulsating ringing current. The relay R is so constructed as to be maintained in continuous operation when this negative pulsating current is passing through its windings, and as pulsations are used of the same direction as the current furnished by the battery B^3 , the relay R is prevented from even momentarily releasing its arma-

tures at the moment the ringing key was depressed. The bell 6 at the subscriber's station may be of the ordinary polarized type as the presence of the condenser 7, which is connected directly in the ringing circuit permits the operation of such a bell from the pulsating source of ringing current. The tip spring of ringing key k^5 is grounded at this time to provide a path to ground for the return current if the subscriber should respond during ringing. Should the subscriber D^2 be the one desired the ringing key k^4 , k^4 , is depressed which serves to connect the generator g^2 with the tip strand of the cord circuit to operate the bell at the station D^2 . The ringing circuit may be traced as follows: from ground at the generator g^2 brush 61, armature winding 60 of the generator, brush 62, through resistance lamp 63, spring k^4 in the tip strand of the cord circuit thence over the tip strand and tip conductor 2 of the line to the station D^2 and thence through condenser 7 and normally closed contacts of the hook 8 and through bell 6 to ground. The bell is thus operated. To maintain the cut-off relay R operated during ringing, the inner contact of the sleeve spring k^4 is connected through a resistance coil 66 with the battery lead 47 extending to the live pole of the battery B^3 . This prevents the de-energization of cut-off relay R while ringing.

It is apparent that the arrangement of the ringing keys is such that either key may be used to call a subscriber at whose station the apparatus is connected in the manner shown at A, which shows the arrangement which I preferably use where but one subscriber is placed upon the line. In this case, the ringing circuit would be complete over the subscriber's metallic circuit, the current returning to the grounded side of the ringing generator by means of the grounded key k^5 or battery contact of the ringing key k^4 .

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 sub-station, 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 de-energized 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 tip relay r^8 upon its forward contact, however, completes the circuit of the locking relay r^{11} as follows: from the live pole of the battery B^3 , conductors 40 and 52, front contact and armature 51 of sleeve relay r^9 , conductor 53 to point 54 thence through the winding of locking relay r^{11} and over conductor 56 to the forward contact of spring 57 of tip relay r^8 and to ground. The locking relay r^{11} therefore operates 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 r^{11} upon its forward contact completes a locking circuit for said relay from the point 59^a through conductor 58 the forward contact and armature of the relay to ground. This circuit and relay are therefore locked and the ringing lamp S^4 locked out during the remainder of the connection, and can only be released when the sleeve relay r^9 is de-energized, which occurs when the plug P^3 is pulled out. Should the tip and sleeve contact so 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^1 is furnishing current over the answering end of the A cord circuit to the A 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 and to the sub-station D to furnish current for talking and for the operation of the several relays. The voice currents are transmitted inductively from the subscribers' line L to the trunk circuit through the condenser 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^2 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 subscriber A that the tip supervisory relay r^2 connected with the A cord circuit is de-energized 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 de-energized. This serves to open the short circuit about the trunk relay r^7 . The current must now flow through the trunk relay r^7 , thus actuating it, but 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 trunk relay r^7 at the incoming end of the trunk of operating current which is therefore de-energized and permits its armature to close upon its back contact the circuit of the disconnecting signal S^5 , said circuit being traced from the live pole of the battery B^3 to conductors 40 and 52, forward contact and armature 51 of sleeve relay r^9 , conductor 53 to point 54, thence through disconnecting lamp S^5 , armature and back contact of trunk relay r^7 , conductor 59 and back contact and armature 57 of tip relay r^8 to ground. The lighting of this signal indicates to the B operator that the A operator has disconnected her cord circuit from the trunk and that the trunk plug P^3 should be withdrawn. Upon withdrawing this plug the sleeve relay r^9 is de-energized and the circuit of the signal lamp S^5 is opened at the front contact of its armature 51. The opening of the circuit at this contact opens the locking circuit of the locking relay r^{11} , which relay is therefore de-energized and permits its armature to return to normal position. All parts are therefore returned 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 of her cord circuit into a wrong 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 over conductor 40, the forward contact and armature of the trunk relay, through the lamp S^5 to point 54, thence over conductor 53, armature 51 and back contact of sleeve relay r^9 to ground. This lamp will therefore glow and will indicate to the B operator that a mistake has been made.

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^5 , or J^6 , and the corresponding signal is transmitted to the waiting subscriber.

Upon inserting the plug P^3 in one of the "busyback" or "don't answer" jacks, for example one of the jacks J^5 , 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^2 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^1 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 de-energized 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 outgoing end of the trunk. 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 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 op-

erator 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^6 , 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 my invention in which the relay r^3 is permanently connected directly between the conductors 35 and 36 of the trunk line, but the tip relay r^8 instead of completing when operated a dead short circuit about the said relay, closes a shunting circuit about the same through its armature 37 and front contact and the conductors 38^a and 39^a, said shunting circuit including the windings w' and w'' of the repeating coil W . In this case the armature of relay r^7 may or may not fall back during conversation. For this reason the circuit of signal S^5 is carried through armature 57 of relay r^8 , but if the resistance of the repeating coil is so adjusted that relay r^7 does not let go, then the signal circuit may be grounded at 59^b. The construction and arrangement is otherwise the same in this figure as in Fig. 1, and the operation is carried out in the same manner. Further description is therefore considered unnecessary.

Fig. 3 shows the trunk relay r^7 connected normally in series with the repeating coil windings w' and w'' between the conductors 35 and 36 of the trunk line, this circuit being completed through the armature 37 and back contact of tip relay r^8 . When the tip relay operates, however, upon the response of the called subscriber it opens this path through the trunk relay and completes a path through its armature 37 and front contact directly between the two windings of the repeating coil. The trunk relay is therefore cut out of the circuit and a path for current between

the two sides of the trunk line is completed through the contacts of the tip relay and the conductor 38^b. Otherwise, the construction, arrangement and operation of this figure is the same as in Figs. 1 and 2, and it is therefore not described in detail.

Fig. 4 shows specifically the same trunk circuit provided with condensers between its outgoing and incoming ends to furnish a path for talking currents in place of the repeating coil windings of the previous figures. The condenser c^9 is connected directly between the trunk conductor 35 and the tip strand t^3 of the trunk cord while the condenser c^{10} is likewise connected between the sleeve conductor 36 of the trunk line and the sleeve strand s^3 of the trunk cord. The tip relay r^8 and the sleeve relay r^9 of the trunk cord are connected in the same manner as before. The trunk relay r^7 is connected with the trunk conductors upon the outgoing side of the condensers c^9 and c^{10} , through retardation coils 80 and 81 whereby it is adapted to be operated by current flowing from the outgoing end of the trunk over the metallic circuit thereof. As in Fig. 1, the tip relay r^8 serves, when operated, to close through its armature 37 and front contact and through conductors 38 and 39 the short circuit of the trunk relay whereby the trunk relay is deprived of operating current and is de-energized. The operation will be apparent from that heretofore described and is therefore not specifically set forth.

Fig. 5 shows the employment of condensers in place of the repeating coil in a circuit corresponding to that of Fig. 2. In this case, the condensers c^9 and c^{10} are connected as in Fig. 4, but the trunk relay r^7 is connected directly and permanently between the conductors 35 and 36 of the trunk line. The branch between the conductors containing the retardation coils 80 and 81 is normally open through the armature 37 and the front contact of the tip relay r^8 . When this relay operates therefore in response to the action of the called subscriber in taking up his telephone, this circuit is closed, and as it is of low resistance as compared with the trunk relay, the latter is deprived of current and is de-energized. It is apparent that the operation described with reference to Fig. 2 can be repeated here, if the resistance of the coils 80 and 81 are adjusted so that r^7 receives sufficient current during conversation to keep the same operated. Branch 59^b only would then be required. The remainder of the operation is the same as described in reference with the other figures and will be readily understood.

The ground connections heretofore referred to, it will be understood, may be 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 practically necessary 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 drawing being to remove the present ground connections and replace them by other conductors and replace the ground upon the opposite pole of the battery. While the exact dimensions of the relays are not the essence of my invention, I have secured good results with trunk relays of 15,000 ohms resistance, tip and sleeve relays of 100 ohms resistance and locking relays of 500 ohms, while the other parts may be of the usual or desired dimensions.

While I have described several forms and several different ways of carrying out my invention, I would have it understood that the invention is not so limited, as it is apparent that various changes and substitutions may be made therein and still come within its scope and principle. But

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

1. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through the said retardation coil, and means actuated by the response of the called subscriber for lowering the resistance between the two limbs of the trunk line and rendering said signal inoperative, substantially as described.

2. The combination with a trunk line, of a cord circuit to connect with its outgoing end, and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, and a supervisory signal associated with the cord circuit and placed in operative condition by current flowing over one side of the cord circuit and through the retardation coil, said signal being adapted to be placed in an inoperative condition by current flowing over the other side of the cord circuit when the called subscriber responds, substantially as described.

3. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, a supervisory signal associated with the cord and placed in operative condition by current

flowing over one side of the cord circuit and through the said retardation coil, and a relay actuated by current flowing over the other side of the cord circuit upon the response of the called subscriber to render said signal inoperative, substantially as described.

4. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, a relay actuated by current flowing over one side of the cord and through said retardation coil, a supervisory signal associated with said cord circuit placed in operative condition by said relay when actuated, a second relay actuated by current flowing over the other side of the talking circuit upon the response of the called subscriber to render said signal inoperative, substantially as described.

5. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the trunk circuit during conversation, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through the said retardation coil, and means actuated upon the response of the called subscriber for rendering said signal inoperative, substantially as described.

6. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil permanently legged to ground from one side of the trunk circuit, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through the said retardation coil, and means actuated by the response of the called subscriber for rendering said signal inoperative, substantially as described.

7. The combination with a trunk line, of a cord circuit to connect with the outgoing end thereof, and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit, a supervisory signal associated with the cord circuit and placed in condition to operate by current flowing through said retardation coil when the cord is connected with the trunk, a high resistance device at the opposite end of the trunk in the path of current thereover, and means actuated by the response of the called subscriber for removing said resistance from the trunk circuit to thereby permit an increased flow of current over the same to render said signal inoperative, substantially as described.

8. The combination with a trunk line, of a

cord circuit to connect with the outgoing end thereof, and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit when the cord is connected with the trunk, the testing strand of the cord circuit being normally connected with a high resistance testing device, a relay adapted to be actuated by current flowing over the other strand of the cord circuit and through said retardation coil to disconnect said testing device and establish the regular talking circuit when the cord is connected with the trunk, substantially as described.

9. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, two relays one associated with one conductor of the cord circuit and one with the other conductor, a supervisory signal mutually controlled by said relays, a source of current associated with said cord circuit, one strand of the cord circuit being normally disconnected from its relay, and the other relay being actuated by current flowing over the other strand of the cord circuit and through said retardation coil when connection is made with the trunk, said latter relay serving to connect the other side of the cord circuit with its associated relay, the latter relay being controlled by the called subscriber, substantially as described.

10. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, two relays one associated with one conductor of the cord circuit and the other with the other conductor, a supervisory signal mutually controlled by said relays, a source of current associated with said cord circuit, one strand of the cord circuit being normally disconnected from its relay and connected with the high resistance testing device, and the other relay being actuated by current flowing over the other strand of the cord circuit and through said retardation coil when the cord is connected with the trunk, said latter relay serving to disconnect the testing device and to connect the other side of the cord with its associated relay, the said latter relay being thereafter controlled by the called subscriber, substantially as described.

11. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected,

a retardation coil legged to ground from one side of the talking circuit when the cord circuit is connected with one end of the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through the said retardation coil when the cord circuit is connected with the trunk, a trunk relay connected with the opposite end of the trunk and actuated by current flowing over the same when the cord is connected with the trunk, a signal at said second end of the trunk controlled by said relay, and means for placing said supervisory signal in inoperative condition by a current flowing over both sides of the trunk when the called for subscriber's telephone is in use, substantially as described.

12. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil permanently legged to ground from one side of the trunk circuit when the cord circuit is connected with one end of the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through said retardation coil when the cord is connected with the trunk, a trunk relay connected with the other end of the trunk and actuated by current flowing over the same when the cord is connected with the trunk, a signal at said second end of the trunk controlled by said relay, and means for placing the said supervisory signal in inoperative condition by current flowing over both sides of the trunk when the called subscriber's telephone is in use, substantially as described.

13. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit when the cord circuit is connected with one end of the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through the said retardation coil when the cord is connected with the trunk, a trunk relay connected with the other end of the trunk and actuated by current flowing over the same side of the trunk circuit with which the retardation coil is connected when the cord is connected with the trunk, a signal at said second end of the trunk controlled by said relay, and means for placing said supervisory signal in inoperative condition by current flowing over both sides of the trunk when the called subscriber's telephone is in use, substantially as described.

14. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one

side of the talking circuit when the cord circuit is connected to one end of the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through said retardation coil when the cord circuit is connected with the trunk, a high resistance trunk relay connected between the trunk conductors and adapted to be actuated by current flowing over the metallic trunk line when the cord is connected with the trunk, a signal adapted to be actuated by said relay, and means for placing said supervisory signal in inoperative condition by the increased flow of current in said trunk when the high resistance of the said relay is removed therefrom, substantially as described.

15. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit when the cord circuit is connected with one end of the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through the retardation coil when the cord is connected with the trunk, a high resistance trunk relay connected at the other end of the trunk between the trunk conductors and adapted to be actuated by current flowing over the metallic trunk line when the cord is connected with the trunk and the called subscriber's telephone is not in use, a signal controlled by said relay, and means actuated when the called subscriber's telephone is in use for removing the high resistance of said relay from the circuit to permit an increased flow of current in the trunk to render said supervisory signal inoperative, substantially as described.

16. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit when the cord circuit is connected with the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through said retardation coil when the cord is connected with the trunk, a high resistance trunk relay connected with the trunk at its opposite end and actuated by current flowing over the trunk when a cord is connected therewith and the called subscriber's telephone is not in use, a signal rendered inert by said trunk relay when energized, and means to shunt said high resistance relay upon the response of the called subscriber whereby an increased flow of current in the trunk renders said supervisory signal inoperative, substantially as described.

17. The combination with a trunk line, of a cord circuit to connect with its outgoing

end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit, a supervisory signal associated with the cord circuit, and adapted to be placed in operative condition by current flowing through the retardation coil when the cord is connected with the trunk, a trunk relay connected with the opposite end of the trunk and actuated by current flowing thereover before the response of the called subscriber, a signal controlled thereby, a supervisory relay associated with the cord circuit and signal and adapted when actuated to render the latter inoperative, said supervisory relay being opened by current flowing over the metallic circuit of the trunk when a called subscriber responds, substantially as described.

18. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to the sleeve side of the trunk, a supervisory relay associated with the sleeve strand of the cord circuit, a high resistance trunk relay at the opposite end of the trunk connected between the limbs thereof, a supervisory relay connected with the tip strand of the cord circuit, an additional relay connected with the tip side of the incoming end of the trunk and adapted to be controlled by the called subscriber when the trunk is connected with the called subscriber's line, whereby when the cord circuit is connected with the trunk the said supervisory sleeve relay is actuated to operate the supervisory signal and the trunk relay is also actuated, but the tip relay does not respond by reason of the high resistance of the trunk relay and when the called subscriber responds the high resistance relay is shunted to permit the operation of the said tip supervisory relay to thereby render the supervisory signal inoperative, substantially as described.

19. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit when the cord circuit is connected with the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through said retardation coil when the cord is connected with the trunk, a trunk relay connected at the incoming end of the trunk and actuated by current flowing over the trunk when the cord is connected therewith, a second relay connected with the trunk and actuated by the response of the called subscriber, and means controlled by said second relay for causing current to flow over the metallic trunk line to render said super-

visory signal associated with the cord circuit at the outgoing end of the trunk inoperative, substantially as described.

20. The combination with a trunk line, of
5 a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit when the cord circuit is connected with the trunk, a super-
10 visory signal associated with the cord circuit and placed in operative condition by current flowing through said retardation coil when the cord is connected with the trunk, a high
15 resistance trunk relay connected at the incoming end of the trunk and actuated by current flowing over the trunk when a cord is connected therewith and before the subscriber has responded, and a second relay at
20 said incoming end actuated upon the response of the called subscriber to shunt the high resistance trunk relay to permit an increased flow of current in the trunk and thereby render said supervisory signal at the
25 outgoing end inoperative, substantially as described.

21. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which
30 its incoming end is adapted to be connected, a supervisory signal associated with the cord circuit and placed in operative condition when the cord is connected with the trunk; a trunk relay at the other end of the trunk actuated when the cord is first connected with
35 the trunk by current over one side of the same with suitable return; a trunk signal operated by the actuation of said relay alone, a second relay associated with the incoming end of the trunk actuated by current
40 flowing over a part of the talking circuit when connection is made with the called line, said relay when thus operated being adapted to prevent the actuation of said
45 trunk signal, and means under the control of the called subscriber for extinguishing said supervisory signal associated with the cord circuit at the outgoing end of the trunk, substantially as described.

50 22. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a supervisory signal associated with the cord
55 circuit and placed in operative condition when the cord circuit is connected with the trunk, a high resistance trunk relay at the other end of the trunk actuated when the cord is first connected with the trunk by current
60 flowing thereover, a relay actuated by current flowing over a part of the talking circuit when connection is made with the called line, and means operated upon the response of the called subscriber to shunt said high

resistance trunk relay and thus permit an increased flow of current over the trunk to
65 render said supervisory signal inoperative, substantially as described.

23. The combination with a trunk line, of a cord circuit to connect with its outgoing
70 end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay actuated by current flowing over a part of the talking circuit including one of
75 the jacks of the called subscriber's line to direct current through said signal to operate the same when the subscriber has been called but before his response, a second relay adapted to deprive said signal of operating current
80 when the subscriber responds, and means for locking out said signal during the remainder of the connection, substantially as described.

24. The combination with a trunk line, of a cord circuit to connect with its outgoing end
85 and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay actuated by current flowing over a part of the talking circuit including one of the jacks
90 of the called subscriber's line to direct current through said signal to operate the same when the subscriber has been called but before his response, a second relay adapted to deprive said signal of operating current when the
95 subscriber responds, and means actuated by said second relay for locking out said signal during the remainder of the connection, substantially as described.

25. The combination with a trunk line, of
100 a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay actuated by current flowing over a part of
105 the talking circuit including one of the jacks of the called subscriber's line to direct current through said signal to operate the same when the subscriber has been called but before his response, a second relay adapted to
110 deprive said signal of operating current when the subscriber responds, and means first actuated by said second relay and thereafter controlled by said first relay for locking out said signal, substantially as described.

26. The combination with a trunk line, of a cord circuit to connect with its outgoing
115 end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay adapted to direct current through said signal to operate the same when the subscriber has been called but before his response, a second
120 relay responsive to current in the called subscriber's line when the subscriber responds, the windings of said relay being out of the path of the voice currents, a locking relay to render said signal inoperative having its cir-
125

cuit initially completed by both said relays and thereafter controlled by the first named relay, substantially as described.

27. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay actuated by current flowing over a part of the talking circuit including one of the jacks of the called subscriber's line to direct current through said signal to operate the same when the subscriber has been called but before his response, a second relay responsive to current in the called subscriber's line when the subscriber responds and having its coil out of the path of the voice currents, a locking relay to render said signal inoperative having its circuit initially completed by both said relays and thereafter controlled by the first named relay, substantially as described.

28. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay connected with one side of the trunk and actuated upon the connection of the trunk with the called subscriber's line, said relay serving to direct current through the ringing signal, a second relay connected with the other side of the trunk and adapted to respond to current in the metallic line when the subscriber responds, a locking relay to render and maintain the said signal inoperative, the circuit of said locking relay being initially completed at one point through contacts of the second relay and thereafter through contacts of the first named relay, substantially as described.

29. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay connected with one side of the trunk and actuated over a part of the talking circuit upon the connection of the trunk with the called subscriber's line, said relay serving to direct current through the ringing signal, a second relay connected with the other side of the trunk and adapted to respond to current in the metallic line when a subscriber is called, a locking relay to render and maintain the said signal inoperative, the circuit of said locking relay being initially completed at one point through contacts of the second relay and thereafter through contacts of the first named relay, substantially as described.

30. The combination with a trunk line, of a cord circuit to connect with the outgoing end thereof and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk

adapted to be operated when the trunk is connected with the called subscriber's line, means for rendering the signal inoperative upon the response of the called subscriber and for locking out the same during the remainder of the connection, and further means under the control of the operator for unlocking said signal after it has been locked without disconnecting the trunk from the called line, substantially as described.

31. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk adapted to be operated when the trunk is connected with the called subscriber's line, means for rendering the signal inoperative upon the response of the called subscriber and for locking out the same during the remainder of the connection, and further means whereby should the signal become accidentally locked out when making a connection the same is unlocked during ringing, substantially as described.

32. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk adapted to be operated when the trunk is connected with the called subscriber's line, a relay for rendering said signal inoperative upon the response of the called subscriber, a second relay for maintaining the first named relay in operative condition during the connection, a locking out circuit for said signal closed initially at one point by the first relay and thereafter maintained closed by the second relay, a ringing key adapted to connect the ringing generator with the called subscriber's line, means for opening the circuit of said second relay by means of the ringing key when the subscriber is being called, whereby should it become necessary for the operator to again ring the subscriber, the signal will be unlocked, substantially as described.

33. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a ringing signal for the incoming end of the trunk, a relay actuated over a part of the talking circuit and adapted to direct current through said signal to operate the same when the subscriber has been called but before his response, a second relay adapted to deprive said signal of operating current when the subscriber responds, and means first actuated by said second relay and thereafter controlled by said first relay for locking out said signal, and a ringing key adapted to open said portion of the talking circuit and to connect the ringing

generator with the called subscriber's line whereby the signal will be unlocked during ringing, substantially as described.

34. The combination with a trunk line, of
5 a cord circuit to connect with its outgoing
end and a called subscriber's line having only
two wires extending throughout the multiple
switchboard with which its incoming end is
connected, a disconnect signal for said in-
10 coming end, means operated by current flow-
ing over a portion of the talking circuit when
connection is made with the called line for
placing said signal in condition to operate
and further means operated by and during
15 the connection of said cord circuit with the
trunk for rendering said signal inoperative,
substantially as described.

35. The combination with a trunk line, of
a cord circuit to connect with its outgoing
20 end and a called subscriber's line having only
two wires extending throughout the multi-
ple switchboard with which its incoming
end is connected, a disconnect signal for said
incoming end, means operated by current
25 flowing over a portion of the talking circuit
when connection is made with the called
line for placing said signal in condition to op-
erate, and further means controlled by cur-
rent sent over the trunk circuit when the cord
30 is connected therewith for preventing the
actuation of said signal, whereby said signal
can only be operated when the cord circuit is
disconnected from the trunk, substantially
as described.

36. The combination with a trunk line, of
a cord circuit to connect with its outgoing
end and a called subscriber's line with which
its incoming end is adapted to be connected,
a signal associated with said incoming end, a
40 single coil relay normally bridged across the
incoming end adapted to be operated by cur-
rent sent over the trunk circuit, a second re-
lay at said incoming end adapted to be oper-
ated by current flowing over a portion of the
45 talking circuit and having its coil out of the
path of the voice currents, said relays jointly
controlling said signal so as to operate the
same to give a guard indication when the
cord circuit is connected with the trunk cir-
50 cuit and the trunk circuit is disconnected
from the said line or to place said signal in
condition to operate so as to give a discon-
nect indication when the cord circuit is dis-
connected from the trunk and the trunk is
55 connected with said line, substantially as de-
scribed.

37. The combination with a trunk line, of
a cord circuit to connect with its outgoing
end and a called subscriber's line having only
60 two wires extending throughout the multiple
switchboard with which its incoming end is
connected, a disconnect signal for said incom-
ing end, means actuated by current flowing
over a part of the talking circuit when con-
65 nection is established with the called line for

controlling the circuit of said signal at one
point to place it in condition to operate, and
further means operated by the connection of
said cord circuit with the trunk for control-
70 ling the circuit of said signal at another point
rendering the same inoperative, substan-
tially as described.

38. The combination with a trunk line, of
a cord circuit to connect with its outgoing
end and a called subscriber's line having only
75 two wires extending throughout the multiple
switchboard with which its incoming end is
connected, a disconnect signal for said incom-
ing end, a relay actuated by current flowing
over a portion of the talking circuit for plac-
80 ing said signal in condition to operate, and a
trunk relay at the incoming end of the trunk
to be actuated by the connection of the cord
circuit with the trunk, the energization of
said trunk relay serving to control the circuit
85 of said signal at a second point rendering the
same inoperative, substantially as described.

39. The combination with a trunk line, of
a cord circuit to connect with its outgoing
end and a called subscriber's line having only
90 two wires extending throughout the multiple
switchboard with which its incoming end is
connected, a disconnect signal for said in-
coming end, a relay actuated over a portion
of the talking circuit when connection is made
95 with a called line for closing the circuit of said
signal at one point, and a trunk relay at the
incoming end of the trunk actuated by cur-
rent from the cord circuit when the cord is
connected with the trunk, said trunk relay
100 serving when energized to open the circuit of
the said signal, substantially as described.

40. The combination with a trunk line, of
a cord circuit to connect with its outgoing
end and a called subscriber's line having only
105 two wires extending throughout the multiple
switchboard with which its incoming end is
connected, a disconnect signal for said incom-
ing end placed in condition to operate by cur-
rent flowing over a portion of the talking cir-
110 cuit when the trunk is connected with the
called line, and means depending upon the
connection of the cord with the trunk to pre-
vent the actuation of said signal during such
latter connection, substantially as described.
115

41. The combination with a trunk line, of
a cord circuit to connect with its outgoing
end and a called subscriber's line having only
two wires extending throughout the multiple
switchboard with which its incoming end is
120 connected, a disconnect signal for said incom-
ing end placed in condition to operate by cur-
rent flowing over a portion of the talking cir-
cuit when connection is established with the
called line, and means to prevent the actua-
125 tion of said signal during such connection
either when the cord is connected with the
trunk or when the called subscriber's tele-
phone is in use, substantially as described.

42. The combination with a trunk line, of 130

a cord circuit to connect with its outgoing end and a called subscriber's line having only two wires extending throughout the multiple switchboard with which its incoming end is connected, a disconnect signal for the incoming end of the trunk, means operated over one side of the talking circuit to direct current through said signal when the trunk is connected with the called line, a trunk relay also at the incoming end of the trunk and actuated when the cord circuit is connected with the trunk, the said trunk relay serving to render the signal inert when the cord is connected with the trunk and to operate the same when the cord circuit is disconnected, substantially as described.

43. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a disconnect signal for said incoming end placed in condition to operate by current flowing over a portion of the talking circuit when connection is made with the called line, a relay at the incoming end of the trunk actuated by current thereover when the cord circuit is connected with the outgoing end, a second relay at the incoming end of the trunk responsive to current in the line when the called subscriber answers, said signal being rendered inert during such connection by the energization of either of said relays, substantially as described.

44. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a disconnect signal for the incoming end of the trunk, a relay actuated by current flowing over a part of the talking circuit when the incoming end of the trunk is connected with the called subscriber's line said relay controlling the circuit of said signal at one point, a second relay connected with the incoming end and controlling said circuit at another point and adapted to be actuated when the called subscriber responds, a trunk relay connected with the outgoing end of the trunk and actuated by current over and between the two limbs of the trunk line, and means whereby said signal is actuated when the first named relay is actuated and the other two relays are de-energized, substantially as described.

45. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a disconnect signal at the incoming end of the trunk, a relay actuated when the incoming end of the trunk is connected with the called subscriber's line to direct current through said disconnect signal, a trunk relay at said incoming end connected with the outgoing end of the trunk and actuated by current thereover

when the cord circuit is connected with the trunk, a third relay connected with the incoming end of the trunk and actuated when the subscriber responds, said signal being rendered inoperative by the operation of either of the trunk relays or the third relay and rendered operative during the connection by the de-energization of said two relays, substantially as described.

46. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is connected, a disconnect signal at the incoming end of the trunk, a relay actuated over a portion of the talking circuit when connection is made with a line to direct current through said signal, a trunk relay connected with the outgoing end of the trunk and actuated by current thereover when the cord circuit is connected with the trunk and the called subscriber's telephone is not in use, a third relay connected with the incoming end of the trunk and actuated when the subscriber responds, said signal being rendered inoperative by the operation of either the trunk relay or the third relay and operative by the de-energization of said two relays, substantially as described.

47. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a guard signal for the incoming end of the trunk, means to actuate said signal by current sent over the two limbs of the trunk line in series when the cord circuit is connected with the trunk and further means actuated by current sent over a portion of the talking circuit when the trunk is connected with a called line for rendering said signal inert, substantially as described.

48. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a guard signal for the incoming end of the trunk, a relay controlling the circuit of said signal at one point and adapted to be actuated over a portion of the talking circuit when the incoming end of the trunk is connected with the called subscriber's line and having its coil out of the path of the voice currents, a trunk relay connected with the outgoing end of the trunk and adapted to be actuated by current flowing over and between the two limbs thereof when the cord circuit is connected with the trunk and controlling the circuit of said signal at a second point, and means for actuating said signal when the first named relay is de-energized and the trunk relay is energized, substantially as described.

49. The combination with a trunk line, of a cord circuit to connect with its outgoing

end and a called subscriber's line with which its incoming end is adapted to be connected, a signal for the incoming end of the trunk, a relay connected at the incoming end of the trunk with the outgoing end and actuated by current thereover from the cord circuit, a second relay connected with the incoming end of the trunk and actuated when the trunk is connected with the called subscriber's line, a third relay at the incoming end of the trunk responsive to current in the line when the subscriber answers his call, the said signal being actuated at different times by current over two different paths, one of said paths being closed when the second relay is energized and the first and third relays de-energized and the other path being closed when the first relay is energized and the second relay is de-energized, whereby in the first instance it serves as a disconnecting signal and in the second as a guard signal, substantially as described.

50. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a signal for the incoming end of the trunk, a relay connected with the outgoing end of the trunk and actuated by current thereover when the incoming end is connected with the called subscriber's line and when the subscriber's telephone is not in use, a second relay connected with the incoming end of the trunk and actuated when the trunk is connected with the called subscriber's line, a third relay at the incoming end of the trunk responsive to current in the line when the subscriber responds, said signal being adapted to be actuated over two different paths, one of said paths including forward contacts of the second relay when it is energized and normal contacts of the other two relays, and the other path including the forward contacts of the first relay when it is energized and normal contacts of the second relay, substantially as described.

51. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a supervisory signal associated with the cord circuit, a relay at the incoming end of the trunk actuated over a part of the talking circuit when connection is made with the line, a testing circuit completed through the normal contacts of said relay, a second relay normally not in condition to operate by current flowing over the line, said first named relay serving when actuated to sever the test circuit and place said second relay in condition to respond when the subscriber answers, and means for controlling the supervisory signal at the other end of the trunk by said second relay, substantially as described.

52. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a supervisory signal associated with the cord circuit, a relay at the incoming end of the trunk actuated over a part of one side of the talking circuit, a testing circuit from the tip of the trunk plug completed through the normal contacts of said relay, a second relay associated with the talking circuit and normally disconnected from the tip, and means for severing the testing circuit and connecting the second relay with the tip and talking circuit when the first named relay is actuated whereby said second relay is placed in condition to operate by current in the line when the subscriber responds, and means actuated by said latter relay for controlling said supervisory signal, substantially as described.

53. In a telephone system, a calling subscriber's line and a called subscriber's line, a cord circuit and trunk to connect said lines together for conversation, a relay associated with said trunk and adapted to operate over a talking strand, a source of distinctive signaling current with which the incoming end of the trunk may be connected when the called subscriber is busy or fails to answer, means for operating said relay when the trunk is connected with said source to place the trunk in condition to respond to the signaling current, whereby the calling subscriber is duly notified of the condition of the called line, substantially as described.

54. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a supervisory signal placed in operative condition by current flowing over a part of the talking circuit when the cord is connected with the trunk, a source of distinctive signaling current with which the incoming end of the trunk is connected when the called subscriber is busy or fails to respond, a device associated with the incoming end of the trunk responsive to said signaling current to cause a flow of current over both sides of the trunk to render said supervisory signal inoperative in accordance with the variations of said current, substantially as described.

55. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a supervisory signal associated with the cord circuit and actuated by current flowing over the trunk when the cord is connected with the trunk, a high resistance device in the path of said current to prevent rendering the supervisory signal inoperative, a source of distinctive signaling current with which the incoming end of the trunk is connected when

the called subscriber is busy or fails to answer, an electro-magnetic device responsive to said signaling current to remove the resistance of said device from the trunk circuit and thereby permit an increased flow of current over the same to render said signal inoperative, substantially as described.

56. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the trunk, a supervisory signal associated with the cord circuit and placed in operative condition by current flowing through said retardation coil when the cord is connected with the trunk, a source of distinctive signaling current with which the incoming end of the trunk is connected when the called subscriber is busy or fails to respond, and means responsive to said signaling current for permitting a flow of current over the metallic circuit of the trunk to render said supervisory signal inoperative, substantially as described.

57. In a telephone system, a calling subscriber's line and a called subscriber's line, a cord circuit and trunk to connect said lines together for conversation, a supervisory signaling apparatus associated with the cord circuit and responsive to current in the trunk, a source of distinctive signaling current with which the incoming end of the trunk is connected when the called subscriber is busy or fails to respond, a relay adapted to be actuated over a part of the talking strand of the trunk, and means to actuate said relay when connection is made with said source, a second relay placed in operative condition by the actuation of said first named relay and responsive to said signaling current, and means controlled by said relay to actuate the supervisory signal in the cord circuit whereby both the calling subscriber and the A operator are notified of the condition of the wanted line, substantially as described.

58. The combination with a trunk line, of a called subscriber's line with which the same is adapted to be connected, a relay adapted to be actuated over a talking strand when the trunk is connected with the called line, a source of distinctive signaling current with which the incoming end of the trunk is connected when the subscriber is busy or fails to answer, means for operating said relay when the trunk is connected with said source, a ringing signal for said incoming end and further means for locking out said signal upon the connection of the trunk with said source, substantially as described.

59. The combination with a trunk circuit, of a cord circuit to connect with its outgoing end and a called subscriber's line with which its incoming end is adapted to be connected,

a relay adapted to be actuated over a talking strand when the trunk is connected with the called line, a source of distinctive signaling current with which the incoming end of the trunk is connected when the subscriber is busy or fails to answer, means for operating said relay when the trunk is connected with said source, further means for causing an interrupted flow of current therefrom over a trunk conductor, a relay in the path of said interrupted current, a disconnect signal for the incoming end of the trunk, said relay serving to control the operation of said disconnect signal so as to operate the same in accordance with said current interruptions when the cord circuit is disconnected from the trunk, substantially as described.

60. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a subscriber's line with which its incoming end is adapted to be connected, a supervisory signal associated with the cord circuit and placed in condition to operate by current flowing over a portion of the talking circuit when the cord is connected with the trunk, a relay associated with the incoming end of the trunk and adapted to be operated over a portion of the talking circuit when the trunk is connected with the called line, a testing circuit for said incoming end of the trunk normally completed over one strand thereof and through normal contacts of said relay, said testing circuit being severed and the trunk circuit being placed in condition for talking by the actuation of said relay, a ringing signal for the incoming end of the trunk placed in condition to operate by the actuation of said relay, means for rendering inert and for locking out said ringing signal during the remainder of the connection, a trunk relay at the incoming end of the trunk actuated by current over the trunk and from the cord circuit when the cord circuit is connected with the trunk, means operated by the said second relay to permit a flow of current over the metallic trunk line to render said supervisory signal inert when the called subscriber responds, a second signal at said incoming end of the trunk placed in condition to operate by the actuation of the said first named relay, means for actuating said signal when the cord circuit is disconnected from the trunk and the trunk is connected with the called subscriber's line, whereby a disconnect indication is given, and further means for actuating said signal when the cord is connected with the trunk and the trunk is disconnected from the called line whereby a guard indication is given, a source of current at the incoming end of the trunk to furnish current for the operation of said relays and signals and for the operation of the transmitters for talking purposes, substantially as described.

61. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord circuit with the trunk, a supervisory signal associated with the cord circuit and placed in condition to operate by current flowing over a portion of the talking circuit and through said retardation coil when the cord is connected with the trunk, a source of current at the incoming end, a relay also associated with the incoming end of the trunk and adapted to be operated by current from said source over one strand of the trunk when connected with the called line, said relay serving when actuated to place the trunk in condition for conversation, a ringing signal for the incoming end of the trunk placed in condition to operate by the actuation of said relay, a second relay responsive to current in the trunk from said source when the subscriber answers his call, said relay serving to render said ringing signal inert, means for locking out said ringing signal during the remainder of the connection, a trunk relay at the incoming end of the trunk and actuated by current thereover when the cord circuit is connected with its outgoing end, means operated by said second relay to permit a flow of current over the metallic trunk line to render said supervisory signal inert when the called subscriber responds, a second signal at said incoming end of the trunk placed in condition to operate by the actuation of said first named relay, said signal being actuated when the cord circuit is disconnected from the trunk and the trunk is connected with the called subscriber's line and the called subscriber's line is not in use, whereby a disconnect indication is given, said signal being also actuated when the cord circuit is connected with the trunk and the trunk is disconnected from the called line whereby a guard indication is given, said source serving to charge the transmitters for talking as well as for the operation of said relays and signals, substantially as described.

62. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord circuit with the trunk, a supervisory signal associated with the cord circuit and placed in condition to operate by current flowing over a portion of the talking circuit and through the retardation coil when the cord is connected with the trunk, a source of current at the incoming end of the trunk, a relay also associated with the incoming end of the trunk and adapted to be operated by current

rent from said source over a portion of the talking circuit when the trunk is connected with the called line, said relay serving when actuated to place the trunk in condition for talking, a trunk relay at the incoming end of the trunk actuated by current thereover when the cord circuit is connected with its outgoing end, a third relay at the incoming end of the trunk adapted to respond to current therein from said source when the subscriber answers his call, a signal at said incoming end having its circuit completed through normal contacts of said trunk relay and said third relay, said signal being placed in condition to operate by the actuation of said first named relay whereby when the cord circuit is disconnected from the trunk and the trunk is connected with the line, a disconnect indication will be given, a second path for current through said signal including the forward contacts of said trunk relay and normal contacts of said first named relay whereby when the cord circuit is connected with the trunk and the trunk is disconnected from the line a guard indication will be given, said source serving to furnish current to the transmitters for talking as well as for the operation of said relays, substantially as described.

63. The combination with a trunk line, of a cord circuit to connect with its outgoing end and a subscriber's line with which its incoming end is adapted to be connected, a retardation coil legged to ground from one side of the talking circuit established by the connection of the cord with the trunk, a supervisory signal placed in condition to operate by current flowing over a portion of the talking circuit and through the retardation coil when the cord is connected with the trunk, a source of current associated with the incoming end of the trunk a relay also associated with the incoming end of the trunk and adapted to be actuated by current from said source over a talking strand of the trunk cord when the same is connected with the called subscriber's line, said relay serving to place the trunk circuit in condition for talking, a trunk relay at the incoming end of the trunk and connected with the outgoing end and adapted to be operated by current thereover when the cord is connected with the trunk, a second relay connected with the incoming end of the trunk and responsive to current from said source in the line when the subscriber answers his call, said relay serving when actuated to permit a flow of current over the metallic trunk line to render the supervisory signal inert and thereby indicate the response of the called subscriber, a disconnect signal for the incoming end of the trunk, said signal being placed in condition to operate by the actuation of said first named relay, and means for preventing the

actuation of said signal by means of said trunk relay when the called subscriber's telephone is not in use and the cord circuit is disconnected from the trunk, said current source
5 serving to furnish current to the transmitters for talking purposes as well as for the operation of said relays, substantially as described.

Signed by me at Chicago, county of Cook,
State of Illinois, this 12th day of June 1902.

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,
G. BEDER.