

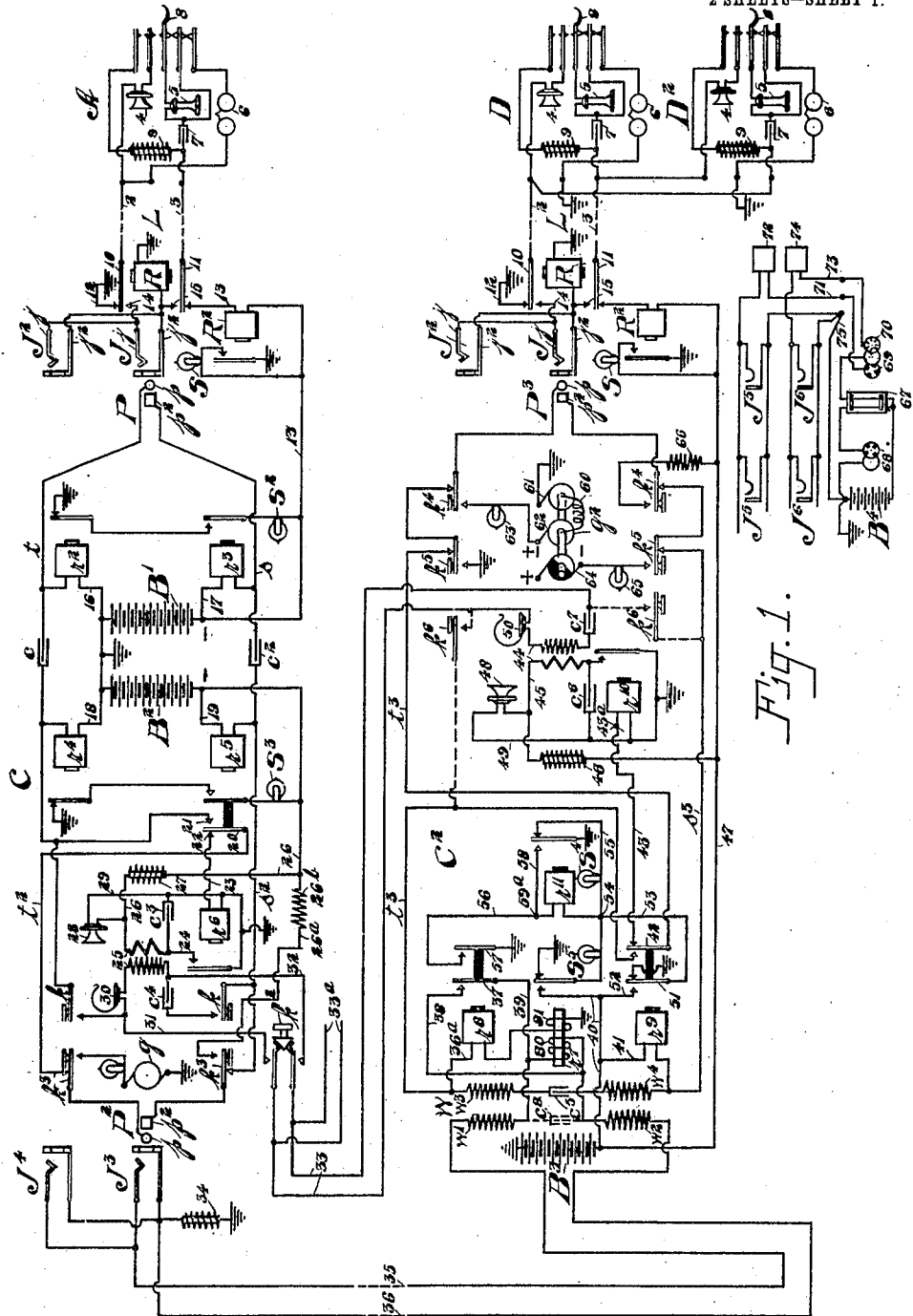
No. 851,803.

PATENTED APR. 30, 1907.

W. W. DEAN.
TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED JULY 14, 1902.

2 SHEETS—SHEET 1.



Witnesses.
R. H. Beauford
T. W. Deane

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

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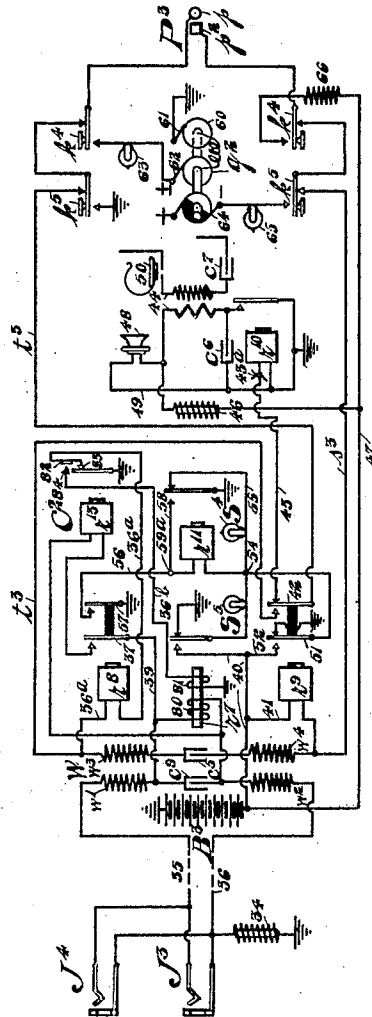


Fig. E.

Witnesses.
R. H. Burfield
H. D. Dulan

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

UNITED STATES PATENT OFFICE.

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

TELEPHONE TRUNKING SYSTEM.

No. 851,803.

Specification of Letters Patent.

Patented April 30, 1907.

Application filed July 14, 1902. Serial No. 115,405.

To all whom it may concern:

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

In an application filed by me June 28th, 1902, Serial No. 113,581, I have shown, described and claimed a system of trunking circuits and apparatus co-operating therewith whereby subscribers whose lines terminate at different switchboard sections may be connected together for conversational purposes.

The present invention relates to the same subject matter as disclosed in the said application, but involves certain modifications and changes whereby the trunk relay remains actuated during the continuance of the conversation with the result that the circuits and apparatus required are somewhat simplified. In order to accomplish this operation of the trunk relay, it is provided with two windings, one a high resistance winding connected permanently with the outgoing end of the trunk line and adapted to be removed from the current path upon the operation of the trunk tip relay, and the other winding being included in a circuit established upon the response of the called subscriber, whereby although the high resistance winding of said relay is rendered inoperative the armature remains attracted during conversation. It is therefore unnecessary to include the normal contacts of the tip relay in the circuit of the disconnecting lamp, whereby the apparatus is simplified.

My invention also contemplates so operating the trunk relay that it is under the control of the A operator, whereby a disconnect or call signal may be given to the B operator even when the called subscriber fails to hang up his receiver.

Other improvements are defined in the claims.

My invention is shown in the accompanying drawing in which

Figure 1 is a diagram of the circuits and apparatus employed in connecting the subscribers between different exchanges, and Fig. 2 is a modification of the trunk.

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, J². 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 j², j², of the jacks J, J². The armature or spring 10 is normally connected with ground through the conductor 12, while the opposite armature 11, is normally connected with conductor 13 containing the line relay R² for the line, said conductor leading to the live, or ungrounded pole of the central battery B', the opposite pole of which is grounded. The line relay R² controls through its armature the circuit of the line signal S. The forward contacts 14 and 15 of the cut-off relay R are adapted to connect the jacks and the 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 p² adapted to register with like contact surfaces j and j² 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 t² of the cord circuit and the interposed condenser c, while the sleeve contacts are likewise connected by the sleeve strands s and s² and the interposed condenser c². A conductor 16 extends from the ground-

ed 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 C². A grounded alternating current ringing generator g is adapted to be connected through a resistance lamp with

the tip strand t^2 of the cord circuit by means of the tip ringing key spring k^3 , the sleeve contact k^3 of said key being connected with battery lead 26 through wire 26^a and resistance 26^b.

A trunk circuit is shown extending between the central offices C and C², said trunk circuit being fitted at the outgoing end with multiple jacks 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 C² where it is provided with suitable means for testing the condition of the wanted line, for ringing the desired subscriber, and with signals to enable the operator to properly attend the connection.

The tip and sleeve trunk conductors 35 and 36 terminate at the incoming office in windings w' and w'' of the repeating coil W and between said windings, the high resistance winding 80 of the trunk relay r^7 is connected. The opposite windings w^3 and w^4 of the repeating coil W are connected with the interposed condenser c^5 between the tip strand t^3 and the sleeve strand s^3 of the trunk cord, these strands terminating in corresponding contacts p and p^2 of the plug P³. A tip relay r^8 is legged to ground from the tip strand t^3 of the trunk circuit by conductor 36^a which also includes low resistance winding 81 of the trunk relay r^7 . This relay controls through its spring 37 and front contact the short circuit composed of conductors 38 and 39 of the high resistance winding 80 of the trunk relay. A sleeve relay r^9 is connected on one side with the live pole of the battery B³ 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 B³. 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 lead-

ing to the central office C. The forward contact of spring 51 of sleeve relay r^3 , is connected by conductor 52 with the conductor 40 leading from the live pole of generator B^3 .

5 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
10 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
15 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 grounded. The forward contact of the
20 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
25 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
30 grounded brush 61, the brush 62 from which the alternating current is directed through the resistance lamp 63 to tip key spring k^4 , when depressed, and brush 64 from the split commutator ring which is adapted to deliver
35 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
40 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 D². The apparatus at these
45 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
50 conductor 2 and ground. The same type of normally disconnected jacks, J, J², line relay, R², cut-off relay R, 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.

60 J⁵, J⁵, and J⁶, J⁶, are respectively "busy back" and "don't answer" jacks associated with the incoming trunks. These circuits comprise an induction coil 67, having its primary in circuit with a rapidly rotating circuit breaker 68 and the battery B^4 , this battery being preferably the same battery as B^3 , though
65 shown separately for convenience. The sec-

ondary 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 J⁵, J⁵,
70 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
75 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
80 breaker 70 to cause distinctive tones at the jacks J⁵ and J⁶, 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
85 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
90 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
95 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
100 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
105 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
110 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
115 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 su-
120 pervisory relay r^3 , sleeve strand s , sleeve contacts p^2 and j^2 of the plug and jack, thence through the winding of the cut-off relay R to ground. The operation of this relay disconnects the armatures 10 and 11 from the
125 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 r^3 over the path
130

just traced serves to close through its armature and front contact the circuit of the supervisory signal S^2 which is associated with the plug P , but it is prevented from glowing, by the operation of the tip supervisory relay r^2 which is connected in the conductor 16 and receives current over telephone line and the tip strand t of the cord circuit and through the conductor 16 to the grounded pole of the battery B' , as soon as the cut-off relay R is operated. The supervisory signal S^2 therefore remains inert while the battery B' furnishes current over the metallic telephone line for the operation of the supervisory relays and for conversational purposes. The operator's transmitter 28 is receiving current at this time from the battery B^2 over the conductor 26 through retardation coil 27, thence through the transmitter 28 and over conductor 29 to ground. When sound waves strike the transmitter 28, the current flowing therethrough is varied which causes a variation of the charge in the condenser c^3 and a corresponding surge of current through the primary of her induction coil 25. These induce voice currents in the secondary which are transmitted to the line and the operator is therefore able to converse with the calling subscriber. Upon learning that a subscriber in the exchange C^2 is desired, the A operator depresses the order key k^2 to connect her telephone with the order wire or circuit 33 and repeats the number of the wanted subscriber to the B operator whose head telephone 50 is permanently connected with the said order wire. The latter operator designates to the A operator the trunk to be used for the connection and proceeds to test the condition of the wanted line with the tip of the plug of the incoming trunk named. 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 P^2 , tip strand t^2 , spring 42 and back contact of sleeve relay r^3 conductor 43 through the common high resistance and impedance test relay or responsive device r^{10} 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 B^3 . 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. The high resistance and high impedance test relay r^{10} or other responsive device prevents noticeably varying the current upon connected lines when the tip of the plug is touched to the test ring of one of the jacks of said line. 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 may be used in place of same or in circuit with the retardation coil but the arrangement described is preferable. This relay is preferably common to all of the incoming trunks at one operator's position as indicated by the branching lines at the point 43^a. On finding the line idle the plug P^2 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 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^2 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 the high resistance winding 80 of the 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 the 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 the winding 80 thereof is very high, sufficient current does not flow over the metallic trunk line to operate the supervisory relay r^4 at the A exchange. 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 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 incom-

ing 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 trunk cord, through the sleeve contacts of the plug and jack and thence through the cut-off relay R of the wanted line to ground. Both the relays are therefore operated, the latter serving to disconnect the line relay R^2 of the called line whereby the line signal is rendered inoperative and the normally disconnected jacks are connected with the line. The operation of the sleeve relay r^9 disconnects the test relay r^{10} and closes the tip strand t^3 through the spring 42 and front contact of the said relay and thereby completes the said circuit for conversation. It also completes the circuit of the ringing lamp S^4 from the live pole of battery B^3 over conductors 40 and 52 and front contact and spring 51 of sleeve relay r^9 , conductor 53 to point 54 thence through the lamp S^4 and over conductor 55 to the back contact and armature of locking relay r^{11} to ground. This lamp being thus lighted indicates that the called subscriber has not yet responded. The trunk relay r^7 being operated at this time opens the circuit of the disconnecting lamp S^5 through its armature and back contact whereby its operation at this time is prevented. 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^5 , k^5 which, as usual, is controlled by a single manually operated lever, 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 the 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-

ture 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 of current if the subscriber should respond during ringing. Should the subscriber D^2 be the one desired the ringing key k^4 , k^4 , controlled by a single lever 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 . In the latter case the auxiliary path around the sleeve relay prevents its being chattered by the ringing current.

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, and back to the central office over limb 2 of the telephone line and thence over tip strand t^3 of the trunk cord to the spring 42 and front contact of sleeve relay r^9 through conductor 36^a including the tip relay r^8 and the auxiliary winding upon the core of the trunk relay to ground. The tip relay responds to this current and closes through its armature 37 and front contact a short circuit of the high re-

sistance winding 80 of the trunk relay r^7 . This resistance being now removed from the path of current flowing in the metallic trunk circuit the tip relay r^4 of the A cord receives sufficient current to operate the same and to thereby open the circuit of the supervisory lamp S^3 , thus indicating to the A operator that the wanted subscriber has responded to his call and that the parties are now in condition to converse. The trunk relay at this time although its high resistance winding is short circuited does not release its armature for the reason that it is attracted by the winding 81 in series with the tip relay. The circuit of the disconnect lamp is therefore held open during conversation. The closing of spring 57 of the tip relay at this time upon its forward contact completes the circuit of the locking relay r^{11} through the live pole of the battery B^3 over conductors 40 and 52, the front contact and spring 51 of sleeve relay r^9 , conductors 53 and 56 through the winding of the locking relay r^{11} to the front contact and armature 57 of the tip relay to ground. This relay is therefore operated and opens through its back contact and armature the circuit of the ringing lamp S^4 , and closes upon its forward contact a locking circuit from the point 59^a over conductor 58 and through the forward contact and armature to ground, this portion of the circuit being in parallel with that completed through the spring 57 of the tip relay whereby the operation of the locking relay becomes independent of the tip relay but is controlled through the sleeve relay. Should the tip and sleeve contacts of the plug be correspondingly crossed for any reason as when the plug is inserted in a jack and the locking and other relays be operated they will be immediately released by the opening of the sleeve strand when the ringing key is operated to call the subscriber.

The subscribers are now connected together for conversation and the supervisory signals at both exchanges are extinguished. The battery B' is furnishing current over the answering end of the A cord circuit to the 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 subscriber's 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^5 between the windings w^3 and w^4 of the repeating coil at the incoming end of the trunk prevent 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 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 and the tip relay r^8 is therefore de-energized which opens the short circuit about the high resistance winding 80 of the trunk relay r^7 . This relay does not release its armature although current is now cut-off from the winding 81 thereof for the reason that the current in the trunk line flows through the winding 80. As this current is not sufficient to maintain the relay r^4 operated in the A cord circuit, the supervisory signal S^3 is lighted and indicates to the A operator the hanging up of the telephone of the called subscriber. 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 line 80 of the trunk relay r^7 of operating current which relay 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 the disconnecting lamp S^5 the armature and back contact of trunk relay r^7 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 withdrawal of this plug the sleeve relay r^9 is de-energized, the circuit of the signal lamp S^5 is opened, the circuit of the locking relay r^{11} is also opened and all parts are returned to normal position. The disconnecting signal S^5 serves also as a guard lamp in case the 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 would be operated while the sleeve relay of the same trunk is not operated. A circuit will therefore be completed from the live pole of the battery B^3 over conductor 40, the front contact and armature of the trunk relay r^7 through the lamp S^5 to point 54 thence over conductor 53 armature 52 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 "busy back" 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^6 to complete the continuity of the tip strand t^3 of the trunk cord through its spring 42 and the front contact. Upon the completion of the strand at this point the tip relay r^8 is provided with current from the live pole of the generator B^4 through the secondary winding of the induction coil 67, through circuit breaker 69 and thence over conductor 71 through resistance 72 and the tip contacts of the jack and plug and over the tip strand and through the relay r^8 to ground. This circuit is interrupted at the breaker 69 so that the relay r^8 is alternately energized and 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.

Fig. 2 shows a modification of the trunk in which the trunk relay is maintained in operated condition during the conversation by means of the current flowing from the trunk line whereby should the called subscriber fail to return his receiver to the hook it would still be possible for the A subscriber to cause the operation of the disconnected signal S^5 at the B exchange by withdrawing the plug of her cord from the trunk. The branch 36^a from the tip strand t^3 which includes the tip

relay r^8 passes to a spring 82 carrying the back contact 83 of the armature of an auxiliary relay r^{13} , said armature being grounded whereby when the subscriber responds a path for current is provided through the tip relay to ground. The relay r^{13} is included in the short circuit or shunting circuit of the high resistance winding 80 of the trunk relay r^7 whereby when the tip relay operates said relay r^{13} is included in the short circuit in parallel with the high resistance 80 and since it is of low resistance the supervisory relay r^4 at the A exchange receives sufficient current to operate the same. As soon as the relay r^{13} is actuated it opens the former circuit of the tip relay r^8 through its armature and back contact but closes the same from the spring 82 to contact 84 and over branch 36^b through the low resistance winding 81 of the trunk relay r^7 to ground, whereby the trunk relay is operated during conversation. The contact at the auxiliary relay r^{13} is made between the spring 82 and point 84 before that between the armature and its back contact 83 is broken whereby the tip relay r^8 is continuously energized. In case the called subscriber should fail to return his telephone to the hook, the circuit through the tip relay r^8 would not be opened at his station as heretofore described in connection with Fig. 1 so that said relay would remain operated. The A operator, however, upon discovering that the subscriber had not hung up his telephone would withdraw the plug P^2 which would deprive the auxiliary relay r^{13} of current and permit its armature to return to normal position under influence of its spring which would open the circuit of the winding 81 of the trunk relay r^7 at the point 84. The trunk relay would therefore be completely de-energized and the circuit of the disconnecting lamp S^5 closed as heretofore described when the trunk plug would be withdrawn. A condenser c^9 is connected directly between the windings w^1 and w^2 of the repeating coil W to provide a free path for voice currents between the two sides of the trunk circuit which would otherwise be hindered by the impedance of the relay r^{13} .

The ground connections heretofore referred to, it will be understood, may and in practice usually are one and the same, or they may be the common office-return, although it is found by experience, that it is 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 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. The high resistance winding of the trunk relay may have 15000 ohms resistance, the low resistance winding 20 ohms, and the auxiliary relay r^{13} may have 20 ohms, although other dimensions may be employed. The other parts may be of any usual or preferred size.

What I claim is:—

1. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and with a called telephone line at its incoming end, of a supervisory signal associated with its outgoing end placed in condition to operate by current flowing over a portion of the talking circuit when connection is established at said end, a trunk relay at the incoming end actuated by current over the metallic circuit of the outgoing end of the trunk when connection is established therewith, said path for current being of high resistance to limit the flow of current in the said trunk line, a signal at said incoming end whose actuation depends upon said trunk relay, and means for removing the resistance of said path from the trunk to permit a sufficient flow of current therein to render inoperative said supervisory signal, and means for maintaining said relay operated during conversation, substantially as described.

2. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with its outgoing end placed in condition to operate by current flowing over a portion of the talking circuit when the connection is established at said end, a trunk relay at the incoming end actuated by current flowing over the metallic circuit of the outgoing end of the trunk when connection is established at said end, a signal at said incoming end whose actuation depends upon said trunk relay, means for removing the resistance of said relay from the trunk to permit a sufficient flow of current therein to render inoperative said supervisory signal, and means for maintaining said relay operated during conversation, substantially as described.

3. The combination with a trunk line adapted to be connected at its outgoing end with a calling telephone line and at its incoming end with a called telephone line, of a supervisory signal associated with the outgoing end placed in condition to operate by current flowing over a portion of the talking circuit, a trunk relay at the incoming end having a high resistance winding and a low resistance winding, said high resistance winding

being connected in the metallic circuit of the outgoing end of the trunk to limit the flow of current therein, a signal at said incoming end whose actuation depends upon said trunk relay, means for removing the high resistance of said winding from the circuit when the called subscriber responds to permit a sufficient flow of current over the trunk to render said supervisory signal inoperative, and means to energize said low resistance winding while the high resistance winding is deprived of operating current, substantially as described.

4. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with the outgoing end placed in condition to operate by current flowing over a portion of the talking circuit when connection is established at said end, a trunk relay at the incoming end having a high resistance winding connected in the metallic circuit of the outgoing end of the trunk to limit the flow of current therein, said relay having also a low resistance winding, a signal at said incoming end whose actuation depends upon said trunk relay, and means to shunt said high resistance winding and to render active the low resistance winding when the called subscriber responds, whereby sufficient current is permitted to flow in the trunk line to render said supervisory signal inoperative and the said relay is maintained operated during the time the high resistance winding is shunted, substantially as described.

5. The combination with a trunk line adapted to be connected with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with the outgoing end and rendered operative by current flowing over a portion of the talking circuit when connection is established at the outgoing end, a trunk relay at the incoming end of the trunk having a high resistance winding connected in the metallic circuit of the trunk to limit the flow of current therein, a signal at said incoming end whose actuation depends upon said relay, a second relay at said incoming end responsive to current in the line when the called subscriber responds, said latter relay serving when actuated to deprive the high resistance winding of said trunk relay of operating current and to permit an increased flow of current in the trunk line to render the supervisory signal inoperative, a low resistance winding for said trunk relay connected in circuit with said second relay during conversation and also responsive to current in the line, whereby said relay is maintained operated while its high resistance winding is inoperative, substantially as described.

6. The combination with a trunk line adapted to be connected with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with its outgoing end placed in condition to operate by current flowing over a portion of the talking circuit when the connection is established at said end, a trunk relay at the incoming end having a high resistance winding and a low resistance winding, said high resistance winding being connected in the metallic circuit of the trunk to limit the flow of current therein to prevent rendering said supervisory signal inoperative, a signal at said incoming end responsive to the actuation of said trunk relay, a second relay at said incoming end responsive to current in the line when the subscriber responds and serving when actuated to remove said high resistance winding from the trunk line and to thus permit an increased flow of current over the outgoing end of the trunk to render said supervisory signal inoperative, the low resistance winding of said relay being in series with said second relay during conversation and also responsive to current in the line, whereby when the high resistance winding is removed as set forth the said trunk relay is maintained actuated by said low resistance winding, substantially as described.

7. The combination with a trunk line adapted to be connected with the calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with said outgoing end and placed in condition to operate by current flowing over a portion of the talking circuit when connection is established at said end, a trunk relay at the incoming end actuated by current thereover, a signal whose actuation depends upon said trunk relay, the circuit of said relay being altered upon the response of the called subscriber to permit a sufficient flow of current over the metallic circuit of the trunk line to render said supervisory signal inoperative and to still maintain the said trunk relay in operated condition, and means under the control of the operator at the outgoing end for rendering said relay inoperative before the called subscriber's telephone is returned to its hook, substantially as described.

8. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and with a called telephone line at its incoming end, of a supervisory signal associated with said outgoing end placed in condition to operate by current over a portion of the talking circuit when connection is established at the outgoing end, a trunk relay at the incoming end having a high resistance winding and a low resistance winding, a signal also at the incoming end whose actuation depends upon said relay,

said high resistance winding being connected in the metallic circuit of the outgoing end of the trunk whereby current flowing in the trunk is limited, means for removing said resistance from the trunk upon the response of the called subscriber to permit a sufficient flow of current in the trunk to render said supervisory signal inoperative, means for energizing said low resistance winding while the high resistance winding is removed, and further means controlled by the operator at the outgoing end for rendering said low resistance winding inoperative before the called subscriber's telephone is hung up, substantially as described.

9. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and with a called telephone line at its incoming end, of a supervisory signal associated with said outgoing end placed in condition to operate by current over a portion of the talking circuit when connection is established at the outgoing end, a trunk relay at the incoming end having a high resistance winding and a low resistance winding, a signal also at the incoming end whose actuation depends upon said relay, said high resistance winding being connected in the metallic circuit of the outgoing end of the trunk whereby current flowing in the trunk is limited, means for removing said resistance from the trunk upon the response of the called subscriber to permit a sufficient flow of current in the trunk to render said supervisory signal inoperative, means for energizing said low resistance winding while the high resistance winding is removed, and further means for rendering said low resistance winding inoperative by the hanging up of the called subscriber's telephone, substantially as described.

10. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with said outgoing end placed in condition to operate by current over a portion of the talking circuit when a connection is established at the outgoing end, a trunk relay at the incoming end having a high resistance winding and a low resistance winding, a signal whose actuation depends upon said relay, said high resistance winding being connected in the metallic circuit of the outgoing end of the trunk whereby the current flowing in the trunk is limited, means for removing said resistance from the trunk upon the response of the called subscriber to permit a sufficient flow of current in the trunk to render the said supervisory signal inoperative, means for energizing said low resistance winding while the high resistance winding is removed, and further means for rendering said low resistance winding inoperative upon the hanging up of the called subscriber's

telephone or by the severing of the connection at the outgoing end of the trunk, substantially as described.

11. The combination with a trunk line
5 adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with the outgoing end placed in condition to operate by current flowing
10 over a portion of the talking circuit when connection is established at said end, a trunk relay having a high resistance winding connected in the metallic line of the outgoing end of the trunk whereby the flow of current therein is limited, a signal whose actuation
15 depends upon said trunk relay, means for removing the said high resistance when the called subscriber responds to render said supervisory signal inoperative, an auxiliary
20 winding upon said trunk relay placed in condition to respond to current in the line while the called subscriber's telephone is in use, said auxiliary winding serving to maintain the trunk relay actuated while its high resistance winding is removed from the circuit,
25 and an auxiliary relay controlling the circuit of said auxiliary winding and placed under the control of the operator at the outgoing end when the called subscriber responds,
30 whereby whenever the connection is severed at the outgoing end of the trunk, the trunk relay is de-energized, substantially as described.

12. The combination with a trunk line
35 adapted to connect with a calling telephone line at its outgoing end and a called telephone line with which its incoming end is connected, of a disconnect signal for said incoming end, a relay at said incoming end actuated by current
40 flowing over a portion of the talking circuit when connection is established with the called line to place said signal in condition to operate, and means controlled by the operator at the outgoing end for operating said
45 signal to give a disconnect indication when the called subscriber's line is closed at the sub-station, substantially as described.

13. The combination with a trunk line
50 adapted to connect with a calling telephone line at its outgoing end and a called telephone line with which its incoming end is connected, of a disconnect signal for said incoming end, a relay at said incoming end actuated by current
55 flowing over a portion of the talking circuit when connection is established with the called line to place said signal in condition to operate, and means for operating said signal when the connection is severed at the outgoing end and when the called subscriber's line
60 is closed at the sub-station, substantially as described.

14. The combination with a trunk line
65 adapted to connect with a calling telephone line at its outgoing end and a called telephone line with which its incoming end is connected,

a disconnect signal for said incoming end, a relay at said incoming end actuated by current flowing over a portion of the talking circuit when connection is established with the called line to place said signal in condition to
70 operate, a trunk relay actuated by current over the trunk when connection is established at the outgoing end to render said signal inoperative, means to energize said trunk relay during conversation, and further means
75 to de-energize said relay before the called subscriber's line is open at the sub-station by severing the connection at the outgoing end of the trunk, substantially as described.

15. The combination with a trunk line
80 adapted to connect with a calling telephone line at its outgoing end and a called telephone line with which its incoming end is connected, of a disconnect signal at said incoming end, a relay at said incoming end actuated by current
85 flowing over a portion of the talking circuit when connection is established with the called line to place said signal in condition to operate, a trunk relay at said incoming end actuated by current over the trunk when
90 connection is established with its outgoing end, means to actuate said trunk relay by current in the line of the called subscriber during conversation to maintain the same operated, and means to cut-off said energizing
95 current when the connection is severed at the outgoing end, substantially as described.

16. The combination with a trunk line
100 adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a relay at the incoming end actuated over a portion of the talking circuit when connection is established with the called line, a trunk relay at the incoming end actuated by current over the outgoing
105 end of the trunk when the called subscriber's telephone is not in use and actuated by current over the incoming end when the called subscriber's telephone is in use, and a disconnect signal whose actuation depends
110 upon said two relays, substantially as described.

17. The combination with a trunk line
115 adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a disconnect signal for the incoming end of the trunk, a relay at said incoming end actuated by current over a portion of the talking circuit when connection is established with the called
120 line to place said signal in condition to operate, a trunk relay adapted when actuated to render said signal inoperative, said relay being first actuated by current over the trunk from the outgoing end and after the called
125 subscriber responds by current flowing over the incoming end of the called line, substantially as described.

18. The combination with a trunk line
130 adapted to connect with a calling telephone

line at its outgoing end and a called telephone line at its incoming end, of a disconnect signal for the incoming end of the trunk, a relay actuated over a portion of the talking circuit when connection is established with the called line, a trunk relay to render the signal inoperative when actuated and having two windings, one of said windings being energized by current flowing over the trunk when connection is first established with the outgoing end and the other winding being actuated by current over the incoming end of the trunk when the called subscriber responds, substantially as described.

19. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a disconnect signal for the incoming end of the trunk, a relay actuated by current flowing over a portion of the talking circuit when connection is made with the called line to place said signal in condition to operate, a trunk relay to render said signal inoperative, said relay having two windings, one of said windings being energized by current over the trunk from the outgoing end and the other being placed during conversation in the path of current flowing over the incoming end of the called line and serving to operate said relay, substantially as described.

20. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a disconnect signal for the incoming end of the trunk, said signal being placed in condition to operate by the connection of the trunk with the called subscriber's line, a trunk relay having an actuating winding connected with the outgoing end of the trunk and energized by current over the trunk from the outgoing end before the called subscriber responds and a second relay at said incoming end actuated when the called subscriber responds and placed under the control of the operator at the outgoing end, an auxiliary winding upon said trunk relay placed in condition to operate by current flowing over the incoming end of the trunk by the actuation of said second relay, whereby said disconnect signal may be operated by the outgoing operator before the called subscriber hangs up his receiver, substantially as described.

21. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a disconnect signal at the incoming end of the trunk placed in condition to operate when the trunk is connected with the called subscriber's line, a trunk relay to render said signal inoperative when energized, said relay having an actuating winding of high resistance connected with the outgoing end of the trunk and ener-

gized by current thereover when connection is established at the outgoing end, a second relay of low resistance connected in the circuit in place of said high resistance winding when the called subscriber responds and actuated by current over the outgoing end of the trunk, an auxiliary winding upon the trunk relay connected in the path of current over the incoming end of the trunk when said second relay is actuated, whereby said auxiliary winding is rendered inoperative when the called subscriber hangs up his telephone or the connection is severed at the outgoing end of the trunk, substantially as described.

22. 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 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 after the called subscriber responds, a trunk relay at the incoming end of the trunk having a winding actuated by current over the trunk and from the cord circuit when the cord circuit is connected with the trunk, means to permit a flow of current over the metallic trunk line to render said supervisory signal inert when the called subscriber responds and an auxiliary winding upon said trunk relay and means for energizing it during conversation to maintain the said relay actuated, a second signal at said incoming end of the trunk placed in condition to operate by the actuation of the 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 to give a guard indication when the cord is connected with the trunk and the trunk is disconnected from the called line, and a source of current at the incoming end of the trunk to furnish current for the operation of the relays and signals and for the operation of the transmitters for talking purposes, substantially as described.

23. 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 connect, 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 of the trunk, a relay 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 said 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 incoming end of the trunk from said source when a called 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 having a high resistance winding and connected with the outgoing end of the trunk and adapted to be actuated by current thereover when the cord circuit is connected with its outgoing end, means operated by said second relay to remove said high resistance winding from the trunk circuit to permit a flow of current thereover to render the supervisory signal at the A cord circuit inoperative, and an auxiliary winding upon said trunk relay energized at the time that the high resistance winding is shunted whereby said relay is maintained actuated during conversation, a second signal at said incoming end of trunk placed in condition to operate by the actuation of said first named relay and prevented from operation by said trunk relay, said signal being actuated to give a disconnect indication when the cord circuit is disconnected from the trunk and the trunk is connected with the called subscriber's line, and said signal being also actuated but to give a guard indication when the cord circuit is connected with the trunk and the trunk is disconnected from the called line, said current source serving to charge the transmitters for talking and to energize said relays and signals, substantially as described.

24. The combination with a trunk line adapted to connect with a calling telephone line at its outgoing end and a called telephone line at its incoming end, of a supervisory signal associated with its outgoing end placed in condition to operate by current flowing over a portion of the talking circuit when connection is established at said end, a trunk relay at the incoming end actuated

when connection is established at the outgoing end of the trunk by current flowing over the metallic circuit of said end, a signal at said incoming end whose actuation depends upon said trunk relay, means for removing the resistance of said relay from the trunk to permit a sufficient flow of current therein to render said supervisory signal inoperative, and further means controlled by current flowing over the incoming end of the trunk for controlling the operation of said relay during conversation, substantially as described.

25. The combination with a trunk line adapted to connect with a cord circuit at its outgoing end, and a called subscriber's line at its incoming end, of a relay associated with the incoming end of said trunk, and a signal having its circuit partially controlled by said relay, the actuation of said relay depending upon either current over the trunk line from the cord circuit or current over the called telephone line, whereby said relay may only be de-energized when the cord is disconnected from the trunk and the called subscriber's receiver is on the hook, substantially as described.

26. The combination with a trunk line, of a cord circuit adapted to connect with its outgoing end, and a called subscriber's line with which its incoming end is adapted to connect, a supervisory signal for said cord circuit adapted to be controlled by the flow of current in the trunk, a signal for said trunk circuit, and a relay to control the circuit of said signal at one point, two coils for said relay, one adapted to be energized by current over the trunk line when the cord is connected with the trunk, and the other adapted to be energized by current over the called subscriber's line when the called subscriber has answered his call, and means to place a shunt about the trunk coil whenever the other of said coils is energized, whereby the current in the trunk line will be increased to control said supervisory signal without the de-energization of the said trunk relay, and whereby said trunk relay remains actuated to control said trunk signal whenever the cord is connected with the trunk or the circuit is closed at the called subscriber's station, substantially as described.

27. The combination with a telephone trunk circuit, of a cord circuit adapted to be connected with said trunk at its outgoing end, and a called subscriber's line with which its incoming end is adapted to connect, of a relay associated with the incoming end of said trunk, and adapted to be actuated by current over the outgoing end of the trunk, a second relay associated with the incoming end of the trunk and adapted to be actuated by current over the called subscriber's line when the circuit is closed at the substation, a coil of said first relay connected in series with

the coil of said second relay, whereby said trunk relay will also be actuated by current in the called subscriber's line, contacts of said second relay adapted to shunt the trunk
5 coil of said trunk relay to decrease the resistance between the limbs of the trunk line, a supervisory signal associated with the cord circuit, and controlled during connection with the trunk by the flow of current in the
10 trunk line, and a signal associated with the in-

coming end of the trunk and having its circuit controlled by the actuation of said trunk relay, 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.