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PATENTED FEB. 26, 1907.

F. W. DUNBAR.
TELEPHONE TRUNKING SYSTEM.

APPLICATION FILED AUG. 23, 1902.

2 SHEETS—SHEET 1.

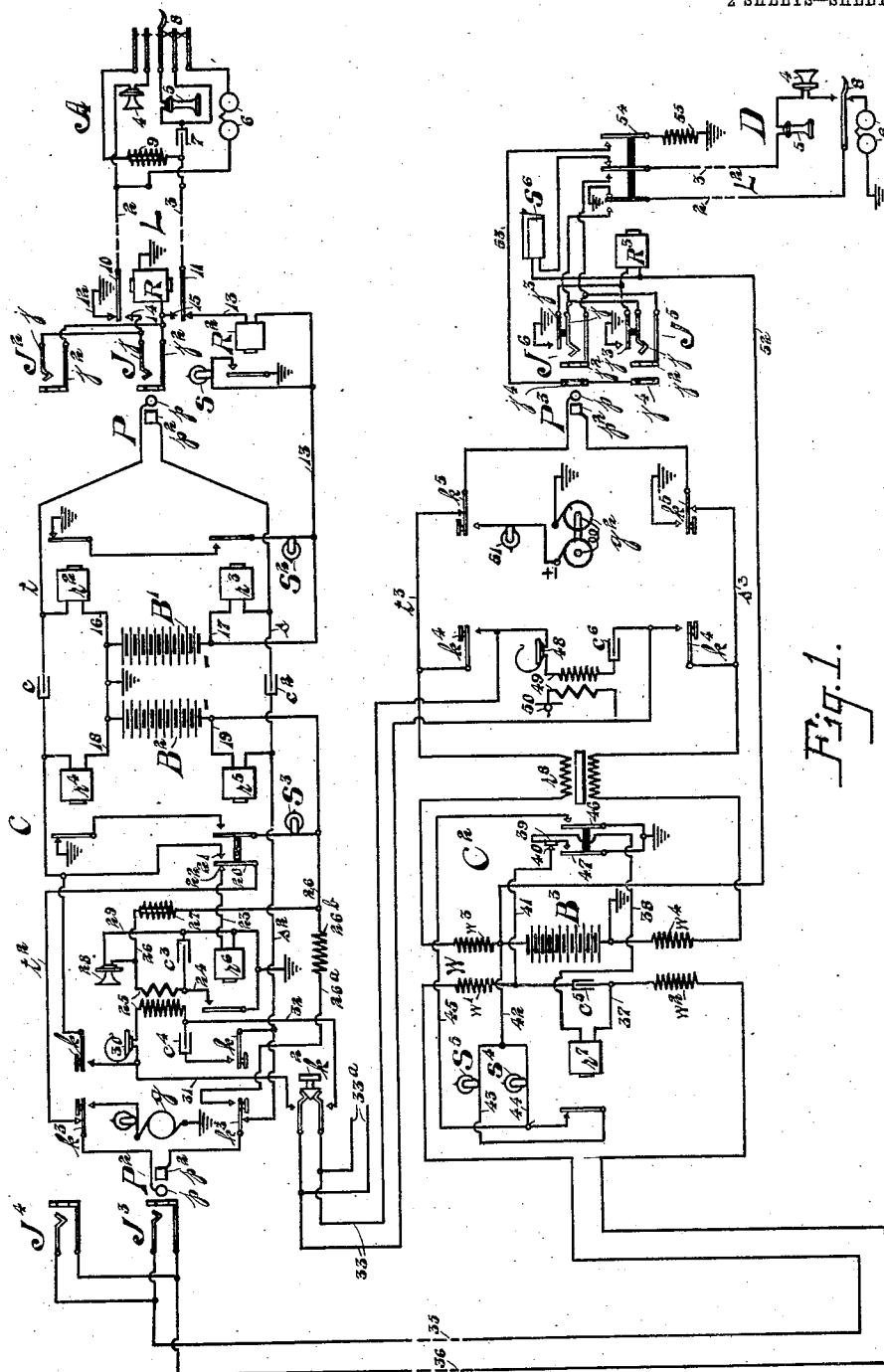


Fig. 1.

Witnessed.
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Eugene Beder

Inventor:-
Francis W. Dunbar,
by Robert Lewis Ames,
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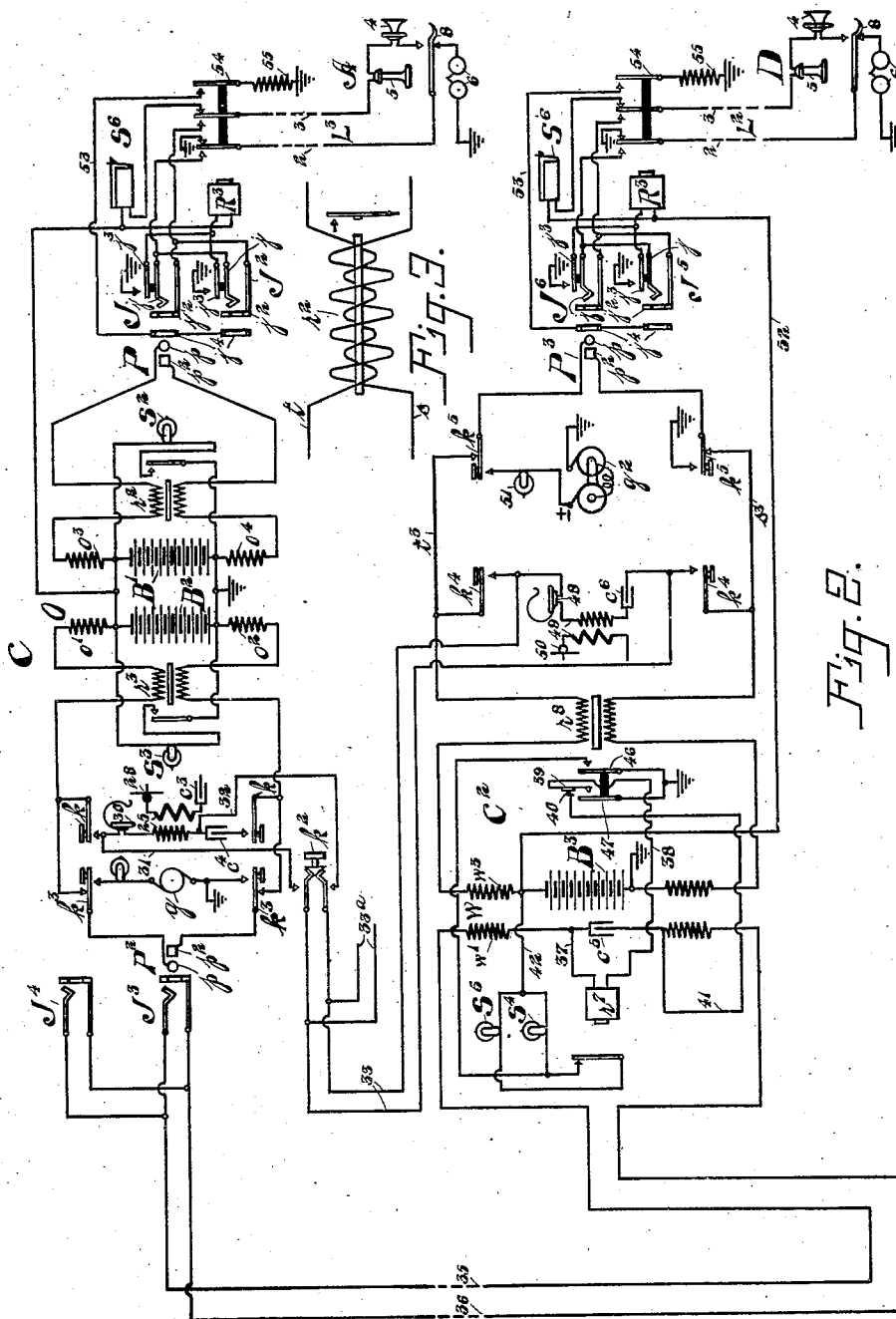


Fig. E.

Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE TRUNKING SYSTEM.

No. 845,452.

Specification of Letters Patent.

Patented Feb. 26, 1907.

Application filed August 23, 1902. Serial No. 120,768.

To all whom it may concern:

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

My invention relates, primarily, to telephone trunk-circuits and apparatus cooperating 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 main types of circuits employed. In both types the subscribers' lines are provided at the central office with a line-signal-controlling electromagnet and a connection to the common battery, whereby when a subscriber desires to call the central office he closes the limbs of the lines together at his station, preferably by taking up his receiver, thus completing the circuit of the common battery through said electromagnet to operate the same, and thereby indicate a call at the central office. The limbs of the telephone-line are also carried through the normally closed contacts of a cut-off relay at the central office, which relay when operated serves to open the line to the battery, and thereby 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, while in the other type the winding of said relay is connected with the line-circuit and is adapted to be operated by current over a portion of the talking-circuit when a connection is established therewith. In the former type of lines a third wire must of necessity be carried through the switchboard and be provided with a special contact in each of the spring-jacks or connection-terminals of the subscriber's line. In view of this arrangement the said special contacts are made use of to determine the busy or idle condition of the subscriber's line. In the other type of lines the cut-off relays are connected directly with the talking-circuit and are energized over a portion of the same when a connection is established, whereby the third wire throughout the switchboard and the third contact of

the spring-jacks are dispensed with. These lines are therefore termed "two-wire" lines.

My present invention relates to trunk-circuits and apparatus whereby lines of the two different types may be connected together in such manner that the usual and best method of operating the trunk-circuits between exchanges may be employed. 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 the incoming trunks.

The invention also consists of the features and arrangements hereinafter described, and particularly pointed out in the appended claims.

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

Figure 1 is a diagram showing a trunking system leading between two central offices, the subscribers' lines at one office being of the two-wire type, while the lines of the other office are of the type employing local circuits for the cut-off relays and testing-contacts. Fig. 2 is a similar view showing a slight modification in the trunk and with subscribers' lines at both offices employing local circuits for testing and for the cut-off relays. Fig. 3 is a detailed view of the differential supervisory relay employed.

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 consist 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 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 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 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 J⁴ or any desired number. The trunk-circuit 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 conductors 35 and 36 terminate at the incoming office in the windings w' and w'' of the repeating-coil W, which are connected together through an interposed condenser c^5 . The opposite windings w^3 and w^4 of the said repeating-coil are connected together through the battery B³, which is common to the exchange C' or to the incoming trunks at said exchange, and at their opposite terminals with the tip and

sleeve strands t^3 and s^3 of the trunk-cord, which strands terminate in the corresponding contacts p and p^2 of the trunk-plug P^3 . A trunk-relay r^7 is connected with the sleeve-strand 36 of the trunk by means of conductor 37 and upon the opposite side, by conductor 38, with the spring-contact 39 of the differential supervisory relay r^8 . The normal contact 40 of said spring 38 is connected by conductor 41 with the tip-conductor 35 of the trunk.

A disconnect-signal S^5 and a ringing-signal S^4 are provided for the incoming end of the trunk. The common conductor 42 leads to the individual branches 43 and 44, containing these limbs, which branches are again connected by a conductor 45, leading to the forward contact of a grounded spring 46 of the differential relay r^8 . In one of the parallel branches the normal branch 43, containing the disconnect-lamp S^5 and the armature of the trunk-relay r^7 , is located and is so arranged as to normally close the same. An additional grounded spring 47 is provided for the differential relay r^8 and when actuated makes contact with spring 39 of said relay and opens the circuit between the spring 39 and contact 40. The operator's receiver 48 is adapted to be bridged across the trunk-cord, together with the secondary of her induction-coil 49 and a condenser c^6 , by means of a listening-key k^4 k^4 , it being understood that these keys are only diagrammatic representations of any ordinary listening-key, the springs of which are operated by a single lever or push-button. The operator's transmitter 50, which is in circuit with the primary of the induction-coil 49, may be charged from the battery B^3 or by means of a local battery.

An order wire or circuit 33 extends from the central office C to the office C². A ringing-generator g^2 is adapted to be connected between ground and the tip-spring k^5 of the ringing-key, the sleeve-spring k^5 thereof being grounded when operated. A resistance-lamp 51 is placed in the path of the ringing-current. The subscriber's line L^2 , terminating at this office, is provided with a number of multiple jacks J^5 J^6 , each of which has the usual tip and sleeve contacts j and j^2 and with third contacts j^3 , which are adapted to be grounded when a connecting-plug is inserted in the jack. These springs j^3 are connected with one side of the cut-off relay R^3 , the opposite terminal of which is connected, by means of a conductor 52, with the live pole of the battery B^3 . Test-rings j^4 are provided for the several jacks and are insulated both when the line is not in use and during a connection. These rings are connected by a conductor 53 with the forward contact of spring 54 of the cut-off relay, said spring being grounded through a suitable resistance 55. A line-signal S^6 is provided for the line

and is connected with the live pole of the battery by conductor 52 and at its opposite terminal with the line conductor 3, which is normally open at the subscriber's station. A bell 6 is provided at the latter station and is connected between the tip limb of the line and ground when the telephone is upon the hook 8, but is disconnected therefrom when the telephone is in use.

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 K^2 , spring 11 of cut-off relay R, limb 3 of the telephone-line, through retardation-coil 9 and transmitter 4 at the substation and thence over limb 2 back to the central office, and spring 10 of cut-off relay R, through conductor 12, to ground. The line-relay K^2 is thus operated and closes the circuit of the signal-lamp S to ground from the conductor 13. The operator upon seeing the line-signal exposed inserts the answering-plug P into the answering-jack J of the subscriber's line and connects her telephone 10 with the cord, circuit by depressing the listening-key k to receive the order from the subscriber. The insertion of the plug P closes a circuit through the cut-off relay R from the live pole of the battery B' through conductor 17, sleeve supervisory relay r^3 , sleeve strand s , sleeve-contacts p^2 and j^2 of the plug and jack, thence through the winding of the cut-off relay R to ground. The operation of this relay disconnects the armatures 10 and 11 from the ground-wire 12 and from the battery-led 13 and connects them through the forward contacts 14 and 15 of said armatures to the normally disconnected jacks J J^2 . The operation of the supervisory relay r^3 over the path just traced serves to close, through its armature and front contact, the circuit of the supervisory signal S^2 , which is associated with the plug P; but it is prevented from glowing by the operation of the tip supervisory relay r^2 , which is connected in the conductor 16 and receives current over telephone-line and the tip-strand t of the cord-circuit and through the conductor 16 to the grounded pole of the battery B' as soon as the cut-off relay R is operated. The supervisory signal S^2 therefore remains inert while the battery B' furnishes current over the metallic telephone-line for the operation of the supervisory 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 there-through is varied, which causes a variation of the charge in the condenser c^3 and a corresponding surge of current through the primary of her induction-coil 25. These induce voice-currents in the secondary, which are transmitted to the line, and the operator is therefore able to converse with the calling subscriber.

Upon learning that a subscriber in the exchange C^2 is desired the A operator depresses the order-key k^2 to connect her telephone with the order wire or circuit 33 and repeats the number of the wanted subscriber to the B operator, whose head-telephone 48 is permanently connected with said order-wire. The latter operator designates to the A operator the trunk to be used 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, for the reason that the test-rings j^4 of the subscriber's line are insulated from ground; but if the line is busy the test-contacts will be connected through resistance 55 to ground, and since the tip-contact of the plug is connected with the live pole of battery B^3 a complete circuit will be established and the operator will receive a click, owing to the variation of the charge of the condenser c^6 . Upon finding the line idle the plug P^3 is inserted in one of the multiple jacks of the line wanted. The A operator, having received the number of the trunk to be used, inserts the calling-plug P^3 of her cord-circuit in the jack of the trunk at her section. The insertion of the plug P^3 closes a circuit from the live pole of the battery B^2 at the A office through conductor 19, the sleeve supervisory relay r^5 , sleeve-strand s^2 of the cord-circuit, sleeve-contacts of the plug and jack, and over the sleeve-conductor 36 of the trunk through conductor 37, the trunk-relay r^7 , conductor 38, spring 39 of relay r^8 , and spring 47 to ground. This circuit is established at the incoming end by reason of the plug P^3 having been inserted in the jack of the line, whereby a path for current from the live pole of the battery B^3 is established over the tip-strand of the trunk-cord and tip side of the subscriber's line and thence through the grounded signaling-bell at the substation. This operates the differential relay r^8 and closes its springs 46 and 47 upon their forward contacts. By means of the current in the path over the trunk just traced the supervisory signal S^3 in the cord-circuit is operated, and thus indicates to the A operator that the called subscriber has not yet responded. The actuation of differential relay r^8 at the incoming end connects a ground upon the limb branches; but as the trunk-relay r^7 is oper-

ated when the lamp S^4 lights it indicates to the B operator that the called subscriber has not yet replied. In calling the subscriber at the station D the ringing-key k^5 is depressed, which sends current over the tip side of the line and through the grounded signaling-bell. In case of the response of the called subscriber during ringing the grounded key k^5 in the sleeve-strand of the trunk-cord provides a ready path to earth for the return ringing-current. Upon the response of the called subscriber the two limbs of the metallic circuit are closed together, and current from the battery B^3 flows over the metallic line, thus furnishing current for the operation of the transmitter at the station D and at the same time closing the magnetic effects of the differential relay r^8 , which consequently releases its springs 46 and 47, the former serving to open the circuit of the ringing-lamp S^4 , to thereby extinguish it and indicate to the B operator that the called subscriber has responded, while the other spring 47 permits contacts 39 and 40 to close together, and thus connect the trunk-relay r^7 of the metallic circuit of the trunk, whereby current is allowed to flow over the metallic circuit of the trunk from the battery B^2 , and since the said trunk-relay is of low resistance it is maintained actuated during conversation and at the same time permits a sufficient flow of current to energize the tip supervisory relay r^4 in the A cord-circuit, which serves to extinguish the supervisory lamp S^3 to indicate to the A operator that the called subscriber has responded. The subscribers are now connected together for conversation. The battery B^1 is furnishing current to the line L for talking purposes and for the operation of the cut-off relay and supervisory relays. The battery B^2 is furnishing current for the operation of the trunk and supervisory relays, while the battery B^3 provides the called line with talking-current and serves also to operate the several relays. The ringing-lamp S^4 is prevented from operating by the deenergization of differential relay r^8 , while the disconnect-lamp has its path opened at a second point by the trunk-relay r^7 .

Upon the termination of the conversation the subscribers' telephones are returned to their hooks, with the result in the case of line L that the supervisory signal S^2 is operated, and at line L^2 the differential relay r^8 is operated by reason of the path for current being established over the tip side of the line through the grounded signaling-bell. Thus the actuation of differential relay r^8 opens the metallic circuit of the trunk-line to thereby render the tip supervisory relay in the A cord-circuit inoperative, which closes the circuit of the supervisory signal S^3 and lights it. This indicates to the A operator the hanging up of the D subscriber's telephone. The cord-circuit is then disconnected from the

trunk and the subscriber's line, thus restoring all parts to normal position at the A office. The disconnection of the cord-circuit deenergizes the trunk-relay r^7 at the incoming end, which closes the circuit of the disconnect-lamp S^5 and causes it to indicate the fact of the disconnection at the A office. The B operator upon seeing signal S^5 therefore takes down the connection at her office, thus restoring all parts to normal position.

Fig. 2 shows specifically the same arrangement at the incoming office, the subscriber's line L^2 being the same and the trunk-circuit being the same, except that the trunk-relay is adapted to be connected between the tip side of the trunk-circuit and ground through the medium of the grounded spring 47 of the differential relay r^8 instead of being connected from the sleeve side, as in the case of Fig. 1.

1. At the A office the subscribers' lines are of the type shown at L^1 , which is the same as the line L^2 at the B office and the parts have been correspondingly designated. The cord-circuit for use at this office is of the type employing differential supervisory relays—that is, the relays are disposed with their windings in the opposite sides of the cord-circuit, whereby when current flows over the metallic line said relays are irresponsive and the supervisory signals controlled thereby are inert; but when current flows over one side of the line or a greater portion flows over one side, so as to unbalance the magnetic effects of the two windings, the said two relays are energized and the lamps are lighted. The batteries B^1 and B^2 are arranged as indicated, and the windings o and o^3 of the repeating-coil O are arranged in inductive relation, while the windings o^2 and o^4 are likewise situated. When the subscriber A calls the central office, the line-signal S^6 is operated by current over the metallic line. The operator inserts the plug P of the cord-circuit into the answering-jack of the line, and thereby closes the local circuit of the cut-off relay R^3 , which is energized from the battery B^1 . This disconnects the line-signal S^6 and connects the test-rings of the jacks to ground. The supervisory signal S^2 remains inert on account of the current flowing over the metallic line through the substation. In order to establish connection with the trunk, the A operator inserts the plug P^2 in one of the jacks thereof, and, as explained with reference to Fig. 1, the plug P^3 of the line has already been inserted in the jack of the wanted line, whereby the differential relay r^8 at the incoming end is operated. A path for current is therefore established over the tip side of the trunk and through the trunk-relay r^7 to ground, the current in this path serving to operate the differential supervisory relay r^3 to close the circuit of supervisory lamp S^3 to thereby indicate that the connection has been made at the called end and that the sub-

scriber has not yet responded. As soon as the called subscriber responds the metallic circuit of the trunk is completed, which permits current from the battery B^2 in the A cord-circuit to flow over the metallic circuit of the trunk to thereby render the differential supervisory relay r^3 inoperative. The supervisory signal s^3 is rendered inert and indicates to the A operator that the called subscriber has responded. The remainder of the operation is the same as described with reference to Fig. 1 and is not deemed necessary to repeat. The several parts of the apparatus have been designated by the same reference characters as in Fig. 1, so that the operation will be readily understood.

Fig. 3 shows the superposed windings of the differential relay, such as is used in both the cord-circuit and trunk of Fig. 2 and the trunk of Fig. 1, these windings being superposed for the purpose of rendering them neutral to the rapidly-varying voice-currents and at the same time permitting the operation of the relay when current flows through one winding only.

The ground connections heretofore referred to may and in practice usually are one and the same, or they may be the common office-return. It is also apparent that the other poles of the batteries may be grounded so far as the general operation of the system is concerned, it being only necessary to reverse the connections from those shown in the drawing. It is also apparent, so far as some features of the invention are concerned, that the lines may terminate in single cords and plugs in place of the double cords shown and described and that the trunks may terminate in jacks in place of plugs and cords.

While I have described one method of carrying out the invention, I would have it understood that the said invention is not to be 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 connected, a disconnect-signal for said incoming end, means operated by current flowing over the called-subscriber's line when connection is made therewith for placing said signal in condition to operate, and further means controlled by the connection of said cord-circuit with the trunk for 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 connected, a disconnect-signal for said incoming end, means operated by

current flowing 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 controlled by current sent over the trunk-circuit when the cord 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.

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 connected, a disconnect-signal for said incoming end, means actuated by current flowing over a part of the talking-circuit when connection 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 governed by the connection of said cord-circuit with the trunk for controlling the circuit of said signal at another point, 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 connected, a disconnect-signal for said incoming end, a relay actuated by current flowing over a portion of the talking-circuit for placing said signal in condition to operate, and a trunk-relay at the incoming end of the trunk and having its action governed by the connection of the cord-circuit with the trunk, said trunk-relay serving to control the circuit of said signal at a second point, 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 connected, a disconnect-signal for said incoming end placed in condition to operate by current flowing over only one of the strands of the talking-circuit when the trunk is connected with the called line, and means to prevent the actuation of said signal during such connection when the cord is connected with the trunk, 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 connected, a disconnect-signal for said incoming end placed in condition to operate by current flowing over only one of the strands of the talking-circuit when connection is established with the called line, and means to prevent the actuation of said signal during such connection when the cord is connected with the trunk or the called-subscriber's telephone is in use, substantially as described.

7. The combination with a trunk-line adapted to be connected with a calling-line at its outgoing end and connected with 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 one side only of the talking-circuit when the connection is established with the said end of the trunk, and means operated upon the response of the called subscriber for permitting the current to flow over both sides of the talking-circuit to render said supervisory signal inoperative, substantially as described.

8. The combination with a trunk-line adapted to be connected with a calling-line at its outgoing end and connected with 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 one side only of the talking-circuit when the connection is made with the trunk at said end, means operated upon the response of the called subscriber for permitting current to flow over both sides of the talking-circuit, and a relay having a winding in the path of said current and energized thereby to render the said supervisory signal inoperative, substantially as described.

9. The combination with a trunk-line adapted to be connected with a cord-circuit at its outgoing end and connected with a called telephone-line at its incoming end, of a supervisory signal associated with the outgoing end, a relay actuated by current flowing over one side only of the talking-circuit when the cord-circuit is connected with the trunk and serving to place said supervisory signal in condition to operate, means operated upon the response of the called subscriber for permitting current to flow over both sides of the talking-circuit, and a relay having a winding in the path of said current and energized thereby for rendering the said supervisory signal inoperative, substantially as described.

10. The combination with a trunk-line adapted to be connected with a calling telephone-line at its outgoing end and connected with a called telephone-line at its incoming end, of a supervisory signal associated with the outgoing end rendered operative by current over one side of the talking-circuit and ground when connection is established at the outgoing end of the trunk, and means actuated when the called subscriber responds for permitting current to flow over the other side of the trunk-circuit to render said signal inoperative, substantially as described.

11. The combination with a trunk-line adapted to be connected with a calling telephone-line at its outgoing end and connected with a called telephone-line at its incoming end, of a supervisory signal associated with the incoming end, the incoming end of the trunk being open to steady currents and one side thereof being connected to ground, said

signal being placed in operative condition by current flowing over said side of the trunk-circuit to ground, a relay having a winding energized when the called subscriber responds for disconnecting said ground and connecting the two sides of the trunk together to permit current to flow over both sides thereof, said flow of current serving to render the supervisory signal inoperative, substantially as described.

12. The combination with a telephone-line adapted to connect with a cord-circuit at its outgoing end and connected with a called telephone-line at its incoming end, of a supervisory signal associated with the cord-circuit and placed in condition to operate by current flowing over one side of the talking-circuit when the cord-circuit is connected with the trunk, a trunk-relay at the incoming end of the trunk connected between the said side and ground, and means to connect said trunk-relay in the metallic circuit of the trunk when the subscriber responds, said relay being of low resistance so as to permit a sufficient flow of current in the trunk-line to render said supervisory signal inoperative, substantially as described.

13. 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 by current over a portion of the talking-circuit when connection is established with the called line, a trunk-relay actuated by current over the trunk as long as the connection exists at its outgoing end to prevent the operation of said signal, substantially as described.

14. 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 by current over a portion of the talking-circuit when connection is established with the called line, a trunk-relay actuated by current over the trunk when connection is established with the line, and means for maintaining said relay actuated during conversation, said relay serving when energized to prevent the operation of said signal, substantially as described.

15. 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 said incoming end placed in condition to operate by current flowing over a portion of the talking-circuit when the trunk is connected with the called line, and means actuated by current flowing over one side only of the trunk-line to prevent the actuation of said signal when the called-subscriber's telephone is not in use and the con-

nection exists at the outgoing end of the trunk, substantially as described.

16. 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 said incoming end, means operated by current flowing 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 controlled by the connection at the outgoing end of the trunk for rendering said signal inoperative, said latter means being operated by current over one side of the trunk and ground, substantially as described.

17. 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 said incoming end placed in condition to operate by current flowing over a portion of the talking-circuit when the trunk is connected with the called line, and means to prevent the actuation of said signal during such connection and when the calling-line is connected with the trunk, said means being actuated by current over one side only of the trunk when the called-subscriber's telephone is not in use and over the metallic trunk-line during conversation, substantially as described.

18. 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 disconnect-signal for said incoming end, means operated by current 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 controlled by current sent over the trunk-circuit when the calling telephone-line is connected with the trunk for preventing the actuation of said signal, said latter means being operated over one side of the trunk and ground when the called-subscriber's telephone is not in use and over the metallic circuit during conversation, whereby said signal can only be operated when the said connection is severed at the outgoing end, substantially as described.

19. The combination with a trunk-line adapted to connect with a calling-line at its outgoing end and a called telephone-line at its incoming end, of a disconnect-signal for said incoming end, means actuated by current flowing over a part of the talking-circuit when connection 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 governed by the connection of the calling-line with the trunk and operated over one side of the trunk and ground for controlling the circuit of said sig-

nal at another point to prevent its operation, substantially as described.

20. The combination with a trunk-circuit adapted to connect at its outgoing end with a calling telephone-line and at its incoming end with a called telephone-line, of a disconnect-signal for said incoming end placed in condition to operate by current flowing over a portion of the talking-circuit when the trunk is connected with the called telephone-line, and a trunk-relay energized by current flowing over one side of the trunk and ground when the calling telephone-line is connected with the outgoing end of the trunk and the called-subscriber's telephone is not in use, and energized during conversation by current over the metallic circuit, said latter relay serving when energized to render said signal inoperative, substantially as described.

21. The combination with a trunk-circuit adapted to connect at its outgoing end with a calling telephone-line and at its incoming end with a called telephone-line, of a relay at the incoming end actuated by current over a portion of the talking-circuit when connection is established with the called line, a trunk-relay actuated by current over the trunk when connection exists at the outgoing end, and a disconnect-signal at the incoming end entirely controlled by said two relays to cause it to give a disconnect indication when connection is severed at the outgoing end and still exists at the incoming end, substantially as described.

22. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end adapted to be operated by current over one side of the talking-circuit thereof when connection exists therewith and to be rendered inoperative by current over the metallic circuit thereof, a relay at the incoming end of the trunk actuated when connection is established with the called line to permit the flow of current over the said one side of the outgoing end, and means for permitting current to flow over the said metallic circuit of the outgoing end when the called party responds, substantially as described.

23. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk placed in condition to operate when a connection is established at said end by current over one side of the talking-circuit of said outgoing end, a relay at the incoming end of the trunk controlling the circuit of the said outgoing end, said relay being operative when the connection is established with the called line and before the response

of the called party and inoperative during conversation, substantially as described.

24. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end placed in condition to operate when a connection is established at said end, a relay at the incoming end of the trunk controlling the path for current over the outgoing end, said relay being energized when the connection is established with the called-subscriber's line and deenergized when the called subscriber responds to permit in the latter condition a flow of current over the outgoing end of the trunk sufficient to render said supervisory signal inoperative, substantially as described.

25. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk placed in condition to operate by current flowing over a portion of the talking-circuit when connection is established at said end, a relay at the incoming end of the trunk controlling the path for current over the outgoing end, said relay being energized when the connection is established with the called line to permit current to flow over the outgoing end of the trunk to actuate said supervisory signal, and means for deenergizing said relay when the called subscriber responds, whereby a low-resistance path for current over the outgoing end of the trunk is completed to permit a sufficient flow of current thereover to render the said supervisory signal inoperative, substantially as described.

26. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, an electromagnetic winding in the path of current over one side of the talking-circuit of the outgoing end of the trunk to place said signal in condition to operate, a second winding in the path of current over the other side of said end to render said signal inoperative when energized, an electromagnet-winding at the incoming end energized when the connection is established with the called line and when the called-party's telephone is not in use, to complete the path for current over the said one side of the outgoing end, and a second electromagnet-winding at the incoming end to be energized when the called party answers to cause the completion of the path for current over the said metallic circuit, substantially as described.

27. The combination with a trunk-circuit extending between different switchboard-

sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when a connection exists at said latter end, a signal at the incoming end whose actuation depends upon said relay, a second relay at the incoming end serving when energized to complete a path for current through said trunk-relay over one side of the outgoing end and when deenergized to complete a path over the metallic circuit of the outgoing end, whereby a suitable actuation of the said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

28. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when connection exists at said latter end, a signal at the incoming end whose actuation depends upon said relay, and a second relay at the incoming end actuated by current over a portion of the talking-circuit when connection is established with the called line to close the circuit of said trunk-relay over one side of the said outgoing end, said relay being rendered inoperative by current over the metallic circuit when the called party responds, whereby a suitable actuation of the said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

29. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when connection exists therewith, a signal whose actuation depends upon said relay, and a second relay at the incoming end actuated by current over the called telephone-line before the subscriber responds to complete a path for said trunk-relay over one side of the outgoing end, said second relay being deenergized when the called subscriber responds to thus close a path over the metallic circuit of the outgoing end for said trunk-relay, whereby a suitable actuation of the said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

30. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines

together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when a connection exists therewith, a signal whose actuation depends upon said relay, and a second relay actuated over one side of the called telephone-line and ground when a connection is established therewith to complete a path for current through said trunk-relay over one side of the outgoing end, said second relay being deenergized when the called subscriber responds to thereby cause the completion of a path for said trunk-relay over the metallic circuit of the outgoing end, whereby a suitable actuation of the said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

31. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a trunk-relay at the incoming end adapted to be actuated by current over the trunk from the outgoing end when connection exists at said end, a second relay at the incoming end of the trunk controlling the circuit of said trunk-relay and suitably actuated by current over the talking-circuit when connection exists with the called line, and a signal at the incoming end controlled solely by said two relays, substantially as described.

32. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when connection exists at said latter end, a signal at the incoming end whose actuation depends upon said relay, and of a differential relay at the incoming end of the trunk suitably actuated when connection exists with the called line and serving to control the circuit of the trunk-relay, whereby a suitable actuation of the said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

33. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a signal at the incoming end of the trunk, a trunk-relay at the incoming end actuated by current over the outgoing end when connection exists at the latter end, a differential relay also at the incoming end and suitably actuated when connection exists with the called line, said signal being controlled by said two relays, substantially as described.

34. The combination with a trunk-circuit

extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a differential relay at the incoming end having a winding in each side of the talking-circuit and unresponsive to current in the metallic line, and a signal at the incoming end whose actuation depends upon said relay, substantially as described.

35. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when connection exists at said latter end, a signal at the incoming end whose actuation depends upon said relay, and a second relay at the incoming end having differential coils, one in each side of the talking-circuit, one of said coils being included in the path of current over one side of the called line and through the grounded signaling-bell branch when connection is made with the line, whereby the differential relay is actuated to close the circuit of said trunk-relay over one side of the outgoing end and when the called party responds the said differential relay is rendered inoperative to thereby close the circuit of said trunk-relay over the metallic circuit of the outgoing end, whereby a suitable actuation of said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

36. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal at the incoming end, a differential relay having a coil in each side of the talking-circuit at the incoming end, said relay being actuated by current through one of its coils when connection has been established with the called line and the called-party's telephone is not in use to place said signal in condition to operate and said relay being rendered inoperative by current in the metallic line when the called party answers, and a trunk-relay actuated by current sent over the outgoing end of the trunk to prevent said signal operating when connection exists at the outgoing end, substantially as described.

37. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end, a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when connection exists at said latter end, a signal at the incoming end whose actuation depends upon said relay, and a sec-

ond relay at the incoming end having differential coils, one in each side of the talking-circuit, one of said coils being included in the path of current over one side of the called line and through the grounded signaling-bell branch when connection is made with the line, whereby the differential relay is actuated to close the circuit of said trunk-relay over one side of the outgoing end and when the called party responds the said differential relay is rendered inoperative to thereby close the circuit of said trunk-relay over the metallic circuit of the outgoing end, said differential relay also controlling the circuit of the trunk-relay, whereby a suitable actuation of the said supervisory signal is secured and at the same time the signal at the incoming end is suitably controlled by the trunk-relay, substantially as described.

38. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal at the incoming end, a differential relay having a coil in each side of the talking-circuit at the incoming end, said relay being actuated by current through one of its coils over one side of the called telephone-line to the substation and thence through the grounded signaling-bell to place said signal in condition to operate, and said relay being rendered inoperative by current in the metallic line when the called party answers, and a trunk-relay actuated by current sent over the outgoing end of the trunk to prevent said signal operating when connection exists at the outgoing end, substantially as described.

39. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated by current over one side of the called line when connection is established therewith to place said signal in condition to operate, and means actuated by current in the metallic line when the called party answers to render said signal inoperative, substantially as described.

40. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated by current over one side of the called line and the grounded signaling-bell at the substation for placing said signal in condition to operate, and means for rendering said signal inoperative when the called party responds, substantially as described.

41. The combination with a trunk-line extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal

for the incoming end of the trunk, a relay actuated by current over a portion of the tip side of the talking-circuit and called line to place said signal in condition to operate, and means responsive to current in the metallic line when the called party responds for rendering said signal inoperative, substantially as described.

42. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated over a portion of the talking-circuit and called line when connection is established with the called line to place said signal in condition to operate, and means for rendering said relay inoperative when the called party responds to thereby render said signal inoperative, substantially as described.

43. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated over a portion of the talking-circuit and called line when connection is established with the called line to place said signal in condition to operate, and means for deenergizing said relay when the called party responds to thereby render said signal inoperative, substantially as described.

44. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated over a portion of the talking-circuit and called line when connection is established with the called line to place said signal in condition to operate, and means actuated by current in the metallic line when the called party answers for rendering said relay inoperative to thereby retire said signal, substantially as described.

45. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a differential relay having a coil in each side of the talking-circuit, means for closing a path through one of the coils when connection is established with the called line to operate the same and thereby place said signal in condition to operate, said relay being rendered inoperative by current in the metallic line when the called party responds to thereby render said signal inert, substantially as described.

46. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk, a

differential relay having a coil in each side of the talking-circuit, means for closing circuit through one of said coils and over one side of the called line to ground at the substation when connection is established with the said line and the subscriber's telephone is not in use, to thereby operate the same and actuate the signal, said relay being rendered inoperative by current in the metallic line when the called party answers to thereby render the said signal inert, substantially as described.

47. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a trunk-relay at the incoming end of the trunk actuated by current from over the outgoing end when connection exists at the latter end, a signal at the incoming end whose actuation depends upon said relay, a second relay at the incoming end having differential coils, one coil in each side of the talking-circuit, a source of current, one of said coils being in the path of current from said source over one side of the talking-circuit when connection is made with the line, whereby the differential relay is actuated at such time, and means for including the said source of current between the said coils and in the metallic circuit of the called line when the called subscriber responds, whereby the said relay is rendered inoperative and the substation-transmitter is charged for talking purposes, substantially as described.

48. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk, means actuated by current over one side of a called telephone-line to place said signal in condition to operate, and means actuated by current over the trunk from the outgoing end when connection exists with said end to prevent said signal operating, substantially as described.

49. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk, means actuated by current flowing over one side of a called telephone-line to the substation and ground to place said signal in condition to operate, and means actuated by current over the trunk from the outgoing end when connection exists at said end to prevent said signal operating, substantially as described.

50. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk,

means actuated by current over one side of the called telephone-line and through the grounded bell at the substation to place said signal in condition to operate, and means actuated by current over the trunk from the outgoing end when connection exists at said end to prevent said signal operating, substantially as described.

51. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk, means actuated by current over the tip side of the called telephone-line and through the grounded bell at the substation to place said signal in condition to operate, and means actuated by current over the trunk from the outgoing end when connection exists at said end to prevent said signal operating, substantially as described.

52. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk, a relay actuated by current over one side of the called telephone-line to place said signal in condition to operate, and a second relay actuated by current over the trunk from the outgoing end when connection exists at said end to prevent said signal operating, substantially as described.

53. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk, a relay actuated by current over one side of the called telephone-line and through the grounded signaling-bell at the substation to place said signal in condition to operate, and a second relay actuated by current over the trunk from the outgoing end when connection exists at said end to prevent the operation of said signal, substantially as described.

54. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a disconnect-signal for the incoming end of the trunk, a relay actuated over a portion of the tip side of the line to place said signal in condition to operate, and a second relay actuated by current over the trunk from the outgoing end to render said signal inoperative, substantially as described.

55. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a ringing signal for the incoming end of the trunk placed in condition to operate by current over one side of the called line to the substation and through the grounded signaling-bell, and

means actuated by current flowing over the metallic circuit when the subscriber responds for rendering said signal inoperative, substantially as described.

56. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect subscribers' lines together for conversation, of a supervisory relay at the outgoing end actuated by current over said end and ground when connection is established at both ends of the trunk, a supervisory signal controlled by said relay, and means actuated upon the response of the called subscriber for disconnecting said ground connection to render the supervisory relay and signal inoperative, substantially as described.

57. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect subscribers' lines together for conversation, of a supervisory signaling device and a source of current at the outgoing end connected between ground and the talking-circuit, a ground connection from said end at the incoming end of the trunk during connection with the called line to provide a return-path for current from said source and means for disconnecting said ground connection when the called party answers, substantially as described.

58. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk placed in condition to operate by current over the tip side only of the trunk when connection is established at said end and with the called line at the other end, and means operated when a called party responds to permit a flow of current over both sides of the trunk to thereby render the said signal inoperative, substantially as described.

59. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, a supervisory signal associated with the outgoing end of the trunk, an electromagnet-winding energized by current flowing over one side of the trunk to place said signal in condition to operate when a connection is established at said end, and means operated upon the response of the called party to permit a flow of current over both sides of the trunk, and an electromagnet-winding in the path of said latter current and adapted to render said supervisory signal inoperative, substantially as described.

60. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk, an electromagnetic device having two windings, one winding being disposed in the path of current over one side only of the trunk, and adapted when energized to operate said

signal, and means operated when the called party responds to permit a flow of current over both sides of the trunk, and a second winding of said electromagnetic device in the path of the latter current and adapted when energized to render said signal inoperative, substantially as described.

61. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signaling device associated with the outgoing end of the trunk having two differential windings connected in the path for current over opposite sides of the trunk, a path for current being completed through one winding and over the tip side of the trunk only when connection has been established at both ends of the trunk, and means operated when the called party responds to permit a flow of current over both sides of the trunk, and through the other winding of said signaling device to thereby render the signal inoperative, substantially as described.

62. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a trunk-circuit, a supervisory signal associated with the outgoing end of the trunk placed in condition to operate by current over the tip side of the trunk with return over a third conductor, the metallic circuit of the trunk being open to prevent a flow of current thereover, and means operated when the called party responds to disconnect said third conductor and complete the metallic circuit of the trunk to permit a flow of current thereover to render said supervisory signal inoperative, substantially as described.

63. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signal associated with the outgoing end of the trunk, an electromagnet-winding connected in the path of current over the tip side of the trunk and ground, and adapted when energized to place said signal in condition to operate, the metallic circuit of the trunk being open to prevent a flow of current thereover, and means operated when the called party responds to disconnect the ground and complete the metallic circuit to permit a flow of current thereover, and a second electromagnet-winding at the outgoing end, the path of the latter current being adapted when energized to render said supervisory signal inoperative, substantially as described.

64. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signaling device associated with the outgoing end of

the trunk having two differential windings, one winding being connected with one side of the trunk and ground when a connection is first established to actuate the same to actuate the signal, and means operated when the called party responds to disconnect the ground from the tip side of the trunk and to connect the two sides of the trunk together to permit a flow of current thereover through the other differential winding of said signaling device, whereby the signal is rendered inert, substantially as described.

65. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a supervisory signaling device associated with the outgoing end of the trunk having differential windings placed in the opposite sides of the talking-circuit and responsive to current over one side of the circuit, the signal being inert when current flows over both sides of the circuit, means for directing an excessive current through one winding when connection is established at the outgoing end to render the signal inoperative, and means actuated upon the response of the called subscriber for equalizing the magnetic effect of the current through said coils when the called subscriber responds whereby the signal is rendered inoperative, substantially as described.

66. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a relay at the incoming end actuated over a portion of the talking-circuit when the trunk is connected with the called line, a trunk-relay at said end actuated by current over the tip side of the outgoing end of the trunk only and ground when the connection is established at the outgoing end and before the called subscriber responds, and a signal at the incoming end whose actuation depends upon said two relays, substantially as described.

67. The combination with a trunk-circuit adapted to connect telephone-lines together for conversation, of a disconnect-signal at the incoming end of the trunk, a relay at said end actuated over a portion of the talking-circuit to place said signal in condition to operate when a connection is established with the called line, and a trunk-relay actuated over the tip side only of the outgoing end of the trunk to prevent the operation of said signal, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 29th day of July, 1902.

FRANCIS W. DUNBAR.

Witnesses:

ROBERT LEWIS AMES,
G. BEDER.