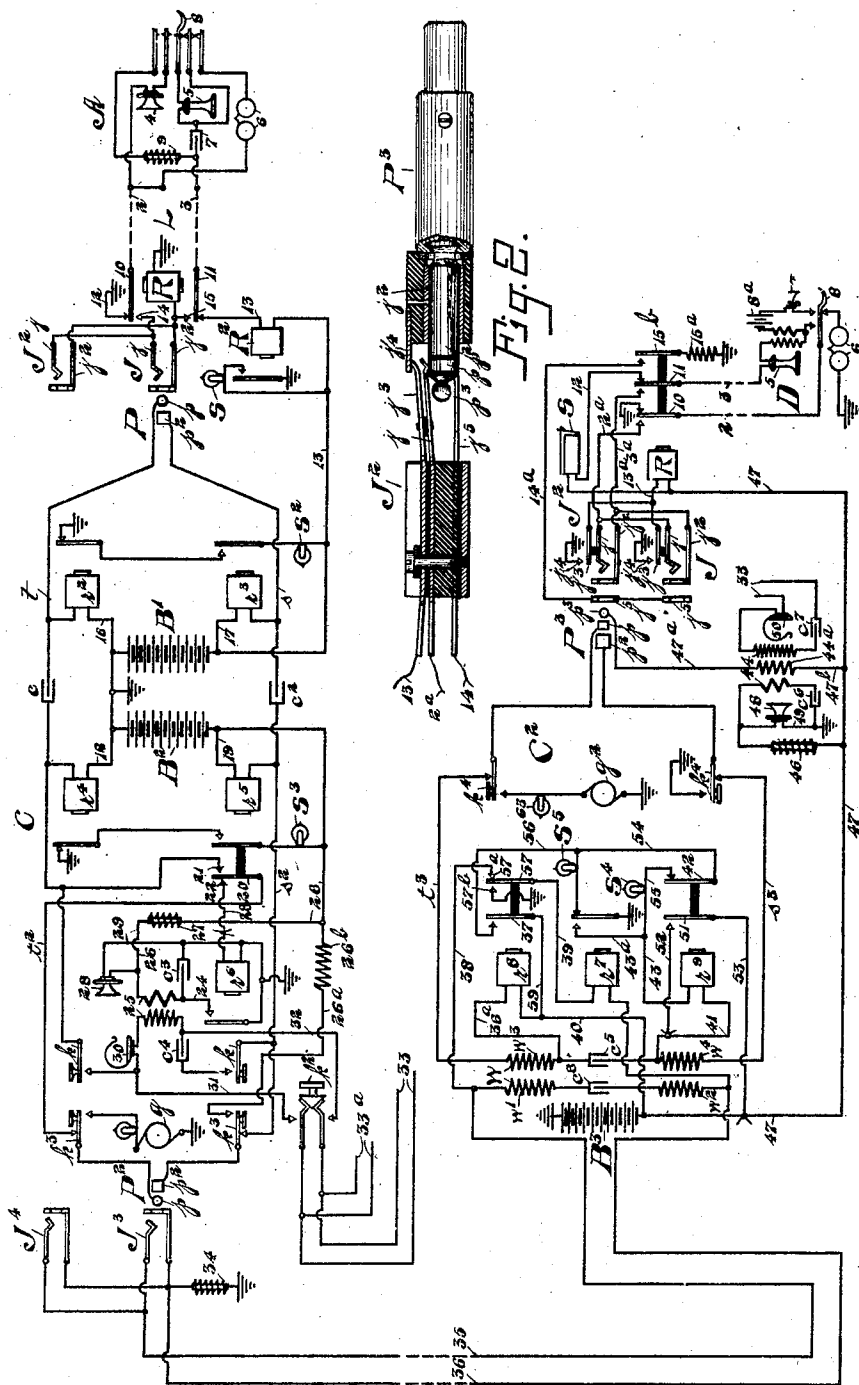


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H. C. GOLDRICK.
TELEPHONE TRUNKING SYSTEM.
APPLICATION FILED SEPT. 17, 1902.



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TELEPHONE TRUNKING SYSTEM.

No. 845,077.

Specification of Letters Patent.

Patented Feb. 26, 1907.

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To all whom it may concern:

Be it known that I, HARRY C. GOLDRICK, a citizen of the United States of America, and a resident of Indianapolis, county of Marion, and State of Indiana, have invented a certain new and useful Improvement in Telephone Trunking Systems, of which the following is a specification.

My invention relates to telephone trunking systems extending between different switchboard-sections and adapted to connect telephone-lines together for conversation.

Although of general application in some of its features, my invention is designed particularly for use in connecting lines of the "Dunbar" or "two-wire" type with lines of the three or four wire type. In the former class of lines, as is well known, the cut-off relays for the lines are actuated over portions of the talking-circuits when connections are established with lines for conversational purposes, while in the latter type the cut-off relays are actuated over local circuits independent of the conversational circuits. In the former type, also, the test-terminals are connected directly with the talking-circuit, while in the latter they are insulated from the talking-circuit, and in the particular lines shown in this application the test-rings are normally insulated but are adapted to be connected with ground during conversation.

In accordance with the operation of my invention the A operator answers the call of a subscriber for a connection in the regular manner, and upon finding that a subscriber is wanted at another exchange she connects her telephone with the order wire or circuit extending to the operator in the B exchange and orders the desired connection. The B operator designates to the A operator the trunk to be used and at the same time tests the condition of the wanted line with the tip of the same incoming-trunk plug. The plug is provided with a special testing contact which is connected, preferably, with a tertiary winding of the operator's induction-coil, whereby when the tip of the plug is brought into engagement with the test-ring of a jack a click will be received if the line is busy and no click will be heard if the line is idle. When the B operator has established connection with the wanted line, the supervisory signal at the outgoing end of the trunk

is lighted and remains lighted until the subscriber responds to his call. A ringing lamp is also provided at the incoming end of the trunk, which is lighted as soon as connection is established with the called line and remains in this condition until the subscriber responds. When the called subscriber answers, both the ringing lamp at the B operator's position and the supervisory lamp at the A operator's position are extinguished, thus indicating the fact of the subscriber's response to both operators. Upon the replacement of the called-subscriber's telephone after the conversation has terminated the supervisory lamp at the A office is lighted, and when the connection has been taken down at that end of the trunk the disconnect-lamp at the B end of the trunk is likewise lighted, whereupon the B operator takes down the connection at that end also. The A operator is thus charged with supervising the connection after it has been established and receives the disconnecting-signals directly from both subscribers. The B operator receives the disconnecting-signal when the A operator has taken down the connection at her office. In order to carry out these various operations, I provide in connection with the incoming ends of the trunks three relays and a source of current, one of said relays being energized by current from said source over one side of the called line to ground at the substation when the subscriber's telephone is upon its hook. The second relay, known as the "trunk-relay," is actuated by current sent over the outgoing end of the trunk when the connection exists at said end, and the third relay is actuated by current in the metallic line when the called subscriber first answers and serves to short-circuit the line, and thereby deprive it of current, and thus to render the first-named relay inoperative. The said third relay serves also to close a locking-circuit for itself, which locking-circuit is preferably the short circuit mentioned.

In the testing operation the trunk-plug is provided with a special testing tip-contact insulated from the other contacts and which does not engage any of the contact-surfaces of the line-jacks when the plug is inserted therein. A conducting-strand connects this contact with the testing apparatus, which

preferably consists of the tertiary winding of the operator's induction-coil and which is connected with the live pole of the battery. The testing-terminals of the switch connections or jacks are normally insulated, but are adapted to be grounded when a connection exists therewith. When the tip of the plug touches a testing-terminal of a busy line, a complete path for current is provided through the said tertiary winding of the operator's induction-coil, and the operator receives a click in her receiver.

The invention further consists in the novel combinations 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 are used throughout to indicate like parts, and in which—

Figure 1 is a diagram representing subscribers' lines leading to different central offices and the trunking connections between said central offices to enable the subscribers to be connected together for conversation, and Fig. 2 is a detail view of the plug and jack which I prefer to use.

Referring to Fig. 1, L designates one of a plurality of subscribers' lines terminating at the central office C. This line extends in two limbs 2 and 3 from the subscriber's station 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 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 the circuit through the call-bell 6 and condenser 7 when placed on the hook 8. 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. At the central office 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 multiple 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-strand s and s² and the interposed condenser c². 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 r², 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 r³. These relays r² and r³ 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 t² and s², respectively, the former conductor including the winding of the supervisory relay r⁴, while the latter includes the similar relay r⁵. These relays serve in a manner similar to the relays r² and r³ to control the circuit of the supervisory lamp S³, associated with the calling-plug P².

The relays r² and r⁴ are conveniently referred to as the "tip-relays" and relays r³ and r⁵ 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 t² of the calling and testing plug P² is normally open through the extra spring or movable contact 20 of the sleeve-relay r⁵, 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 r⁶, 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 B^3 , 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^2 . 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 office C and C^2 , said trunk-circuit being fitted at the outgoing end with multiple jacks, such as J^3 and J^4 , and a retardation-coil 34, connected to ground from the sleeve side of the circuit. The trunk extends in two limbs 35 and 36 to the central office C^2 , where it is provided with 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 ends in the winding w' and w'' of the repeating-coil W and the interposed condenser c^5 . The trunk-relay r^7 is connected on one side with the conductor 36 and on the other by means of conductor 39 with the spring 57 of the tip-relay r^8 . The normal contact 57^a of said spring is joined by conductor 38 with the other conductor 35 of the trunk, so that when the tip-relay is deenergized the trunk-relay is energized over the metallic circuit of the trunk. The forward contact 57^b of said spring 57 is grounded, whereby when the tip-relay r^8 is operated, the trunk-relay is energized over the sleeve-conductor 36 of the trunk and ground. The opposite windings w^3 and w^4 of the repeating-coil W are connected with an interposed condenser c^6 between the so-called "tip-strand" t^3 and the sleeve-strand s^3 of the flexible cord of the trunk, the said strands terminating in the corresponding contacts p and p^2 of the trunk connecting-plug P^3 . The tip-relay r^8 is connected on one side by conductor 36^a with the tip-strand t^3 of the trunk-cord and on the other side by conductor 40 with the live pole of the battery B^3 . A sleeve-relay r^9

is joined on one side by means of conductor 41 with the sleeve-strand s^3 of the trunk-cord and on the other side by means of conductors 43 and 43^a with the forward contact of the trunk-relay r^7 , the armature of which is grounded, whereby when the trunk-relay is operated and current is present on the sleeve-strand of the cord the said sleeve-relay is operated over conductors 41 and 43^a and the armature of the trunk-relay to ground. A locking-circuit for this relay is provided, consisting of its armature 51, connected by conductor 53 with the battery-lead 47 and adapted when operated to close upon its forward contact with a conductor 52, extending between said forward contact and the conductor 41, whereby when once actuated this relay locks itself through the spring 51 and forward contact and the armature of the trunk-relay. A ringing signal S^4 in the form of a small incandescent-lamp is provided, said signal being actuated when the tip-relay r^8 is energized and the trunk-relay also energized. The circuit of this lamp is completed over the grounded armature of the trunk-relay, conductor 43^a, conductor 55, containing the lamp S^4 , the normal contact or spring 42 of the sleeve-relay r^9 , conductors 54 and 56, to the forward contact of spring 37 of the tip-relay r^8 , thence through the armature of the tip-relay by conductor 59 to the conductor 40, leading from the live pole of the battery B^3 . This circuit is open when either the trunk-relay is deenergized or the sleeve-relay energized. A disconnect-signal S^5 is included between the back contact of the armature of the trunk-relay and the junction-point of conductors 54 and 56, whereby when the trunk-relay is deenergized and the tip-relay energized this lamp will receive current from the battery B^3 and be lighted. The extreme tip of the plug is provided with an extra contact p^3 , which is connected by conductor 47^a with one terminal of the tertiary winding 44^a of the operator's induction-coil 44, which is connected on the other side by means of conductor 47^b with the battery-lead 47. The operator's transmitter 48 is actuated by current from the battery-lead 47, flowing through the resistance 46 and through the transmitter branch 49 to ground, the primary of the operator's induction-coil and a condenser c^6 being connected in a shunt of the transmitter. The operator's receiver 50 is included in series with the secondary of her coil and the condenser c^7 and are connected with the order-wire leads 33, leading to the A exchange. When a busy line is tested, therefore, the operator will receive a click. The trunk-cord is also arranged for signaling a subscriber by means of the ringing generator g^2 , connected through the resistance-lamp 63 with the tip ringing-key k^4 , the similar key in the sleeve being grounded.

The subscriber's line is of the local-battery

type provided with common-battery calling apparatus. This line is provided with line conductors 2 and 3, the former being normally connected by the switch-hook 8 with the grounded signaling-bell 6, while the latter includes the receiver 5 and the secondary winding of the operator's induction-coil and is then connected with the upper contact of the telephone hook-switch, so that when the hook raises the two limbs of the line are connected together. A local battery 8^a is provided in connection with the primary of the induction-coil and the transmitter 4, this local circuit being closed when the receiver is removed from the switch-hook. At the central office the jacks J and J² are provided with the tip and sleeve contacts j¹ and j², respectively, connected in multiple with each other and with the conductors 2^a and 3^a, normally disconnected from the line conductors 2 and 3, but adapted to be connected therewith by the operation of the cut-off relay R upon the insertion of a connecting-plug into one of the jacks, the circuit of this relay being closed through the normally open contacts j³ and j⁴ of the jacks, the former of which is connected with the conductor 13^a, leading to one terminal of the cut-off relay, the other terminal of which is connected with the battery-lead 47. When, therefore, a plug is inserted into the jack, the circuit of the battery is closed through the cut-off relay, and the same is operated. The normal contact of the spring 10 of the cut-off relay is grounded, while the corresponding contact of the spring 11 is connected by wire 12 with one side of the line-signal S, the other side of which is connected with the battery-lead 47, whereby when the subscriber takes up his receiver a circuit for the battery B³ is provided through the line-signal S over the sleeve-limb of the telephone-line and back to the central office over the tip-limb of the line to ground. The jacks of the lines are also provided with testing contacts j⁵, which are connected, by means of conductor 14^a, with the front contact of the spring 15^b of the cut-off relay, the latter being grounded through a suitable resistance 15^a. When the cut-off relay is operated, therefore, these test-rings are grounded.

As shown in Fig. 2, the tip-contact of the plug does not connect with any of the contacts of the jack when inserted and cannot become crossed with the other contacts thereof while making the connection, and the test-rings or test-contacts of the jacks do not touch the sleeve of the plug when the latter is inserted in a jack.

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 B¹ through conductor 13, line-relay R², spring 11 of cut-off relay R, limb 3 of the telephone-line, through retardation-coil 9 and transmitter 4 at the 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 R² is thus operated and closes the circuit of the signal-lamp S to ground from the conductor 13. The operator upon seeing the line-signal exposed inserts the answering-plug P into the answering-jack J of the subscriber's line and connects her telephone 30 with the cord-circuit by depressing the listening-key k k to receive the order from the subscriber. The insertion of the plug P closes a circuit through the cut-off relay R from the live pole of the battery B¹ through conductor 17, sleeve supervisory relay r³, sleeve-strand s, sleeve-contacts p² and j² of the plug and jack, thence through the winding of the cut-off relay R to ground. The operation of this relay disconnects the armatures 10 and 11 from the ground-wire 12 and from the battery-lead 13 and connects them through the forward contacts 14 and 15 of said armatures to the normally disconnected jacks J J². The operation of the supervisory relay r³ over the path just traced serves to close through its armature and front contact the circuit of the supervisory signal S², which is associated with the plug P, but it is prevented from glowing by the operation of the tip supervisory relay r², which is connected in the conductor 16 and receives current over the telephone-line and the tip-strand t of the cord-circuit and through the conductor 16 to the grounded pole of the battery B¹ as soon as the cut-off relay R is operated. The supervisory signal S² therefore remains inert while the battery B¹ furnishes current over the metallic telephone-line for the operation of the supervisory relays and for conversational purposes. The operator's transmitter 28 is receiving current at this time from the battery B² over the conductor 26 through retardation-coil 27, thence through the 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 c³ and a corresponding surge of current through the primary of her induction-coil 25. These induce voice-currents in the secondary, which are transmitted to the line, and the operator is therefore able to converse with the calling subscriber.

Upon learning that a subscriber in the exchange C² is desired the A operator depresses the order-key k² to connect her telephone with the order wire or circuit 33 and

repeats the number of the wanted subscriber to the B operator, whose head-telephone 50 is permanently connected with the said order-wire. The latter operator designates to the A operator the trunk to be used for the connection and proceeds to test the condition of the wanted line with the tip of the plug of the incoming trunk named. If the line wanted is idle, no click will be received; but if busy the test-rings of the jacks of the line will be grounded through the spring 15^b of the cut-off relay, and since the tip of the plug is connected with the live side of the battery through conductor 47 and 47^a a complete circuit will be established and current will flow through the tertiary winding of the operator's induction-coil, thus inductively causing a click in the operator's receiver. The operator's receiver will respond to this click at all times, even though the order-circuit be open at the A exchange, owing to the electrostatic capacity of the circuits connected with her receiver. Upon finding the line idle the plug P³ is inserted in one of the jacks of the wanted line. As soon as the plug P³ is inserted in the jack of the wanted subscriber the calling-key k⁴ is operated, which connects the ringing generator g² with the tip-conductor of the telephone-line and operates the grounded signaling-bell 6 over the tip-limb of the said line. As soon as the ringing key is closed the tip-relay is operated by current from the battery B³, flowing over the conductor 40 from the tip-relay r³, thence over conductor 36^a, and through the tip-strand t³ of the trunk-cord over the tip side of the telephone-line through the grounded signaling-bell 6. This relay is therefore operated and connects its spring 57 with its grounded forward contact and the spring 37 with its forward contact, the latter serving to close the circuit of the ringing lamp S⁴ at one point. The A operator, having received the number of the trunk, inserts the calling-plug P² of her cord-circuit in the trunk J³ of the jack at substantially the same instant that the trunk is connected with the called line. This has the effect of closing the circuit from the live pole of the battery B² at the A office through conductor 19, sleeve supervisory relay r⁵, sleeve-strand s² of the circuit, sleeve-contacts of the plug and jack, and through the retardation-coil 34 to ground. This has the effect of positively operating the sleeve supervisory relay r⁵, which cuts out the test-relay r⁶ in the cord-circuit and completes the tip-strand of the cord for conversational purposes. At the same time a path for current is also completed over the sleeve side 36 of the trunk through the trunk-relay r⁷, over conductor 39, through contacts 57 and 57^b of the tip-relay r⁸ to ground, thus operating the trunk-relay r⁷ and causing it to close its forward contacts, which completes the circuit of the

ringing lamp S⁴, thus permitting it to light and at the same time preventing the lighting of the disconnect-signal S⁵. Upon the response of the called subscriber the two limbs of his line are connected together at the sub-station, which permits current from the battery B³ to flow back to the central office over the sleeve side of the line and through the sleeve-strand s³ of the trunk-cord, thence over conductor 41, through the sleeve-relay r⁹, conductors 43 and 43^a, through the forward contact of the trunk-relay to ground. The closing of this circuit actuates the sleeve-relay, causing it to close through its spring 51 and forward contact, a path for current from the battery over lead 47, through the conductor 53, spring 51, its forward contact and conductor 52, thence through conductor 41, sleeve-relay r⁹, conductors 43 and 43^a to the contacts of the trunk-relay and ground. This circuit is therefore in parallel with the path for current over the metallic telephone-line and serves to shunt the current in the line which deprives the tip-relay r⁸ of operating-current and permits its armatures to resume their normal contacts. This parallel path is, moreover, a locking-circuit for the sleeve-relay completed through the forward contacts of the trunk-relay. The deenergization of the tip-relay r⁸ results in opening the circuit of the ringing lamp S⁴, which is rendered inert, thus indicating to the B operator the response of the called subscriber. The return of spring 57 of the tip-relay r⁸ to its normal contact completes the metallic circuit of the outgoing end of the trunk and permits current to flow thereover and operate the tip supervisory relay in a cord-circuit to open the circuit of the supervisory signal S³ to render the same inert, thus indicating to the A operator that the called subscriber has responded. The resistance of the trunk-relay r⁷ is such as to permit a sufficient flow of current in the metallic circuit of the outgoing end of the trunk for the operation of the tip supervisory relay, as stated. The subscribers are now in conversation, and the supervisory signals, in connection with the cord-circuit and trunk, are extinguished. The battery B' is furnishing current over the answering end of the cord-circuit to the A subscriber's line for talking purposes and for the operation of the several relays and signals. The battery B² is furnishing current over the trunk-line for the operation of the several relays associated with the called end of the A cord and with the incoming end of the trunk, while the battery B³ is sending current through the sleeve-relay r⁹ and the cut-off relay R.

The voice-currents are transmitted inductively from the subscriber's line L to the trunk-circuit through the condenser c and c² in the A-cord circuit and from the trunk-circuit to the incoming end thereof and the

subscriber's line connected therewith through the medium of the repeating-coil W. The condenser c^5 , between the windings w^3 and w^4 of the repeating-coil at the incoming end of the trunk, prevents the flow of steady current therethrough, but permits the free passage of voice-currents, while the condenser c^8 allows the passage of voice-currents without hindrance or retardation from the trunk-relay r^7 .

At the termination of the conversation the subscribers return their receivers to the hooks, with the result in the case of subscriber A that the tip supervisory relay r^2 , connected with the A-cord circuit, is deenergized and closes through its armature and back contact the circuit of the supervisory signal S^2 , thus indicating to the operator that subscriber A has hung up his receiver. When the subscriber D hangs up his telephone, a path for current is again completed through the tip-relay r^8 over the tip sides of the trunk-cord and the telephone-line and through the grounded signaling-bell. This relay is therefore operated, opening the metallic circuit of the outgoing end of the trunk and completing the grounded circuit of the trunk-relay, which remains energized. The tip supervisory relay in the A cord is deenergized, however, which permits the corresponding supervisory lamp to ignite, thus indicating to the A operator that the called subscriber has returned his receiver to the hook. Upon observing both supervisory signals lighted the A operator takes down the connection with the trunk, which deprives the trunk-relay r^7 of operating-current, thus allowing its armature to close the circuit of the disconnect signal-lamp through its back contact, this circuit being now completed through the forward contact and spring 37 of the tip-relay r^3 . The deenergization of the trunk-relay r^7 breaks the locking-circuit of sleeve-relay r^9 ; but the ringing lamp does not light, for the reason that its circuit is open at the forward contact of the trunk-relay. The B operator, observing the lighting of the lamp S^5 , understands that it is time to take down the connection, when the plug P^3 is withdrawn, thus restoring all parts to normal condition.

Owing to the shunting-path of the locking-circuit before described, current is taken off from the telephone-line, as it is not needed for conversational purposes, due to the local battery B^a at the exchange being used for conversational purposes.

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 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 on one side of the common battery. It is also apparent that the other poles may be grounded so far as the operation of the system is concerned, the only variation necessary being to remove the present ground connections and replace them by other conductors and place the ground connections upon the opposite poles of the battery.

While the exact dimensions of the relays are not the essence of my invention, I have secured good results with a trunk-relay of two hundred and fifty to five hundred ohms resistance and the other relays and apparatus of the usual or desired size.

It is also apparent that so far as some features of the invention are concerned the lines may terminate in single cords and plugs in place of the double cord shown and described and the trunks may terminate in jacks in place of the plugs and cords.

While I have described one specific method of carrying out my invention, I would have it understood that it is not to be so limited, as it is apparent to those skilled in the art that various modifications 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-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal at 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 prevent a sufficient flow of current over the outgoing end of the trunk to render the supervisory signal inoperative, and a relay actuated when the called subscriber responds to deprive the said first-named relay of operating-current, said relay serving when deenergized to complete a low-resistance path for current over the metallic circuit of the outgoing end of the trunk to render said supervisory signal inoperative, substantially as described.

2. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal at the outgoing end placed in condition to operate when a connection has been established with said end, a relay at the incoming end, said relay being energized when the connection is established with the called subscriber's line and before his re-

sponse to open the metallic circuit of the outgoing end of the trunk, and means to shunt said relay to close the metallic circuit of the outgoing end of the trunk when the called party responds to cause it to permit a flow of current thereover to render said supervisory signal inoperative, substantially as described.

3. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal at the outgoing end operated when connection is established therewith, a trunk-relay at the incoming end actuated by current from over the outgoing end when connection is established at said end, a second relay at said incoming end actuated when connection is established with the called line and when the called subscriber's telephone is not in use, for closing an operating-circuit through said trunk-relay over one side of the outgoing end of the trunk and ground, and means for shunting said second relay during conversation to cause it to complete the metallic circuit of the outgoing end of the trunk through said relay whereby a flow of current over the outgoing end renders said supervisory signal inoperative, substantially as described.

4. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal at the outgoing end operated when connection is established therewith, a trunk-relay at the incoming end of the trunk actuated by current thereover when a connection exists at the outgoing end, a relay at the incoming end actuated by current over one side of the called line and ground when a connection is established therewith and when the called subscriber's telephone is not in use to complete a path for current through said trunk-relay over one side of the outgoing end of the trunk and ground, a third relay at the incoming end actuated over the metallic line when the called subscriber answers, said relay serving to short-circuit the second-named relay whereby the latter is deenergized and when deenergized closes the metallic circuit of the outgoing end of the trunk through the trunk-relay to maintain the latter operated and at the same time to permit a sufficient flow of current over the trunk to render the supervisory signal inoperative, substantially as described.

5. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a supervisory signal at the outgoing end of the trunk placed in condition to operate by current flowing over one side of the trunk at the outgoing end when a connection is first established therewith, a relay and a source of cur-

rent at the incoming end, said relay being actuated by current over one side of the telephone-line and the substation-ground before his response, said relay serving to control a path for current over the outgoing end of the trunk, a second relay at the incoming end of the trunk responsive to current in the line when the subscriber responds, said latter relay serving to short-circuit the first-named relay to render it inoperative and thereby close the path for current over the metallic circuit of the outgoing end of the trunk to render said supervisory signal inoperative, said second-mentioned relay serving also to deprive the called line of current and to close a locking-circuit for itself, substantially as described.

6. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a relay and a source of current associated with the incoming end, said relay being adapted to be operated by current from said source over one side of the line to ground at the substation before the subscriber answers, of a signal placed in condition to operate by the actuation of said relay, a second relay at the incoming end of the trunk responsive to current in the metallic line when a called subscriber answers, said latter relay serving to short-circuit the first-named relay to render it inoperative and to deprive the line of current, and a locking-circuit for said second relay to prevent deenergizing the same as long as the connection exists at the outgoing end of the trunk, substantially as described.

7. 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 sent over the outgoing end of the trunk to prevent the operation of said signal while a connection exists at the outgoing end, a second relay at the incoming end of the trunk placed in condition to operate by current sent over one side of the called telephone-line to ground at the substation to place said signal in condition to operate when the called subscriber's telephone is upon its hook, and a third relay at the incoming end responsive to current in the metallic line when the subscriber answers to his call to short-circuit the line and thereby render said second-mentioned relay inoperative and to deprive the line of current, and a locking-circuit for said third relay to prevent its operation as long as a connection exists at the outgoing end of the trunk, substantially as described.

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

nect-signal for the incoming end of the trunk, a relay actuated over one side of the called telephone-line and ground at substation to place said signal in condition to operate, a second relay at the incoming end actuated by current sent over the outgoing end of the trunk when a connection exists at the outgoing end to prevent the operation of said relay, a third relay at the incoming end of the trunk responsive to current in the line when the called subscriber first takes up his receiver, and a locking-circuit for said relay in shunt of the line, whereby when the said relay is actuated a line is deprived of current and the first-named relay is rendered inoperative, substantially as described.

9. 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 actuated when connection is established with the called line, a relay energized by current in the talking-circuit when the called subscriber answers to render said signal inoperative, and means to prevent deenergizing said relay until the connection is severed at the outgoing end, substantially as described.

10. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a relay associated with the incoming end of the trunk actuated over one limb of the called line when connection is established therewith, a ringing signal whose circuit is controlled at one point by said relay, a second relay responsive to current in the line when the called subscriber answers to render said signal inoperative, said relay serving to close a locking-circuit for itself when actuated and to open the circuit of said signal at a second point, whereby said signal is prevented from operating during the remainder of the connection, substantially as described.

11. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines together for conversation, of a relay associated with the incoming end of the trunk actuated when connection is established with the called line, a ringing signal whose circuit is controlled at one point by said relay, a second relay connected with the sleeve-strand of the trunk-cord and responsive to current in the line when the subscriber answers, said relay when actuated serving to close a locking-circuit for itself and to shunt the circuit from the winding of said first relay and open the circuit of said signal at a second point, substantially as described.

12. 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 one side of the telephone-line to the substation and ground to place said signal in condition to operate, and a second relay responsive to current in the metallic circuit of the line to render said first relay inoperative when the called subscriber responds, substantially as described.

13. The combination with a trunk-circuit extending between different switchboard-sections adapted to connect telephone-lines for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated over one limb of the called subscriber's line and ground when connection is established with said line to place said signal in condition to operate, and a second relay responsive to current in the metallic line for rendering said signal inoperative, said latter relay serving to close a locking-circuit for itself whereby said signal is prevented from operating during the remainder of the connection, substantially as described.

14. The combination with a trunk-circuit extending between different switchboard-sections and adapted to connect telephone-lines for conversation, of a ringing 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 to place said signal in condition to operate, and a second relay actuated over the metallic line when the called subscriber responds to render said signal inoperative, said latter relay serving when actuated to complete a locking-circuit for itself, whereby the ringing signal is prevented from operating during the remainder of the connection, substantially as described.

15. The combination with a trunk-circuit extending between different switchboard-sections adapted to connect telephone-lines for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated over one side of the called line, and through the grounded signaling-bell to place said signal in condition to operate, and a second relay actuated over the metallic line when the called subscriber answers to render said ringing signal inoperative, said latter relay when actuated closing a locking-circuit for itself whereby the ringing signal is prevented from operating during the remainder of the connection, substantially as described.

16. The combination with a trunk-circuit extending between different switchboard-sections adapted to connect telephone-lines for conversation, of a ringing signal for the incoming end of the trunk, said signal being actuated when connection is established with the called line, a relay actuated in the metallic line when the called subscriber responds to render said signal inoperative, said

latter relay when actuated closing a path for current in shunt of the line to deprive the line of current, substantially as described.

17. The combination with a trunk-circuit
5 extending between different switchboard-
sections adapted to connect telephone-lines
for conversation, of a ringing signal for the
incoming end of the trunk, said signal being
actuated when connection is established
10 with the called line, a relay actuated in the
metallic line when the called subscriber re-
sponds to render said signal inoperative, said
relay serving when actuated to close a lock-
ing-circuit for itself in shunt of the line
15 whereby the line is deprived of current, sub-
stantially as described.

18. The combination with a trunk-line
extending between different switchboard-
sections and adapted to connect a called
20 subscriber's line with a cord-circuit which

has been connected with a calling subscriber's
line, of a source of current associated with
the incoming end of the trunk, of a relay as-
sociated with said end actuated from said
source over the called subscriber's line be- 25
fore his response to his call, and a signal-cir-
cuit closed at one point by the actuation of
said relay, a second relay actuated to deprive
said first relay of energizing-current when the
called subscriber answers and at the same 30
time to close a locking-circuit for itself and
to open said signal-circuit at a second point,
substantially as described.

Signed by me at Indianapolis, county of
Marion, State of Indiana, this 29th day of 35
August, 1902.

HARRY C. GOLDRICK.

Witnesses:

H. F. BACON,

A. HOFFMEYER.