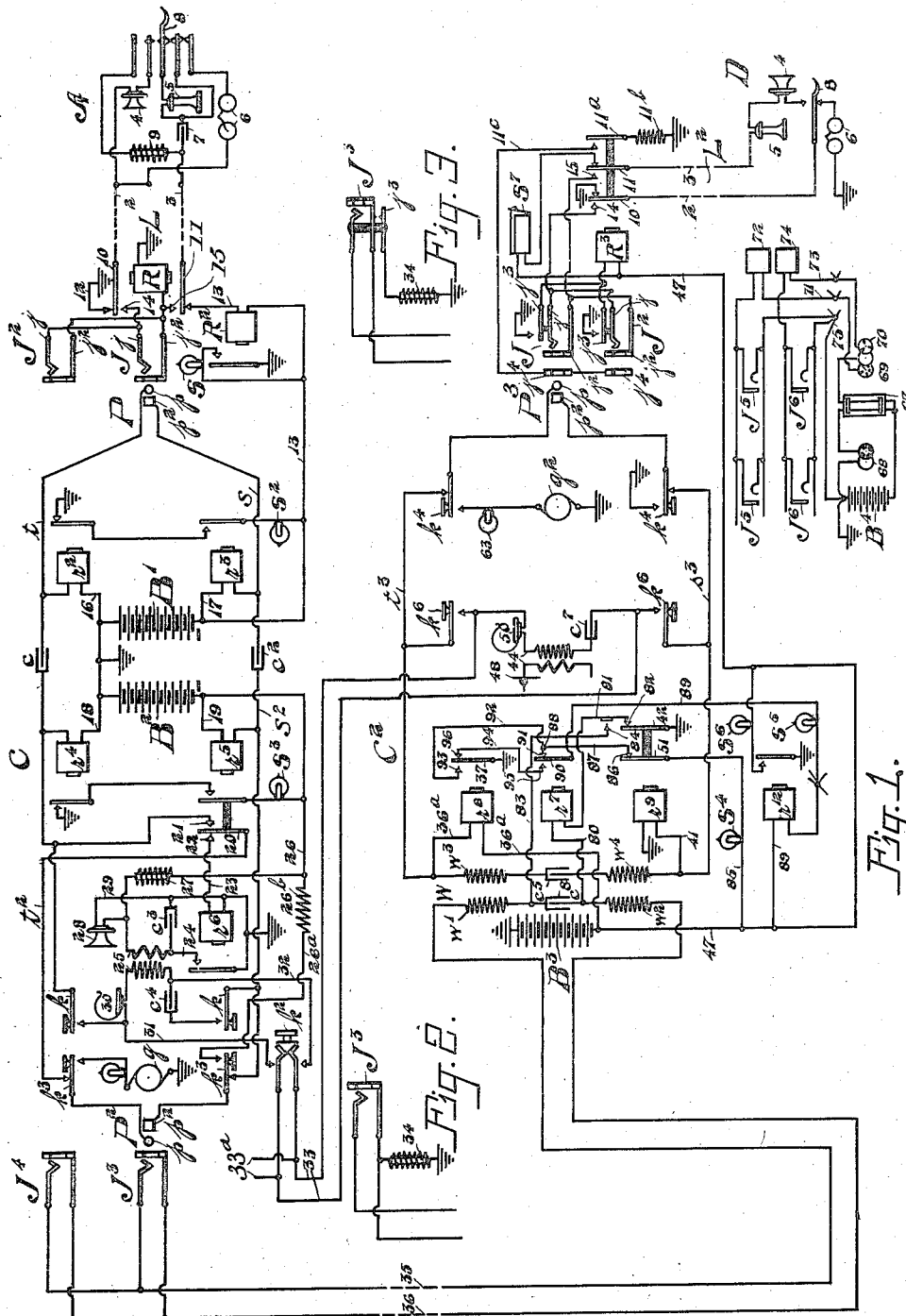


H. G. WEBSTER.
TELEPHONE TRUNKING SYSTEM.
APPLICATION FILED AUG. 1, 1902.



Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE TRUNKING SYSTEM.

No. 853,286.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, 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 to telephone trunking systems adapted to connect together for conversational purposes telephone lines terminating at different switchboard sections.

In an application filed by William W. Dean, June 28th, 1902, Serial No. 113,581, a trunking system is shown extending between different switchboard sections at which terminate subscribers' lines of the Dunbar or two-wire type.

My invention relates to trunk systems designed more particularly for use with lines of the "Dunbar" or "two-wire" type at the outgoing end and lines of the "three" or "four" wire type at the incoming end.

In lines of the former type, it is well known, the cut-off relays are actuated over a portion of the talking circuit, while in lines of the latter type, such devices are actuated over entirely local circuits.

Some of the novel features of my invention are capable of use in various relations and all such uses are contemplated as being within the limits of my improvements.

My invention has for its objects the provision of a trunking system, having means to enable the operators to properly select a suitable trunk, to call the desired subscriber, and to supervise the connection.

My invention is illustrated by the accompanying drawings in which

Figure 1 is a diagram of subscribers' lines terminating at different central offices with a cord circuit at one office and a trunk extending between said offices to connect the lines together for conversation; Fig. 2 is a modification of the outgoing end of the trunk, and Fig. 3 is also a modification of the outgoing end.

Referring to Fig. 1, L designates one of a plurality of subscribers' lines terminating at the central office C, said lines being of the "two-wire" or "Dunbar" type. 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 it through the call bell 6 and condenser 7. A retardation coil 9 is connected at the sub-station when the hook is raised, in parallel with the receiver 5, and condenser 7, to provide a path transparent to steady currents but opaque to voice currents. The line conductors 2 and 3 include respectively the armatures or springs 10 and 11 of the cut-off relay R which is permanently legged to ground from the sleeve contacts j², j², of the jacks J, J². The armature or spring 10 is normally connected with ground through the conductor 12, while the opposite armature 11, is normally connected with conductor 13 containing the line relay R² for the line, said conductor leading to the live or ungrounded pole of the central battery B', the opposite pole of which is grounded. The line relay R² controls through its armature the circuit of the line signal S. The forward contacts 14 and 15 of the cut-off relay R are adapted to connect the jacks and the switchboard section of the line with the external line circuit when the said cut-off relay is energized.

At the central office C, the usual operator's cord circuit is provided, said cord circuit having an answering plug P and a calling plug P², each being provided with a tip contact p and a sleeve contact p² adapted to register with like contact surfaces j and j² in the jacks of the line when the plug is inserted therein. The tip contacts of the plugs are connected together by means of the tip strands t and t² of the cord circuit and the interposed condenser c, while the sleeve contacts are likewise connected by the sleeve strands s and s² and the interposed condenser c². A conductor 16 extends from the 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 r^3 . These relays r^2 and r^3 serve to control the circuit of the supervisory lamp S^2 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 B^2 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 S^3 associated with the calling plug P^2 .

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 plug and testing plug P^2 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 B^2 , 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 offices C and C^2 , said trunk circuit being fitted at the outgoing end with multiple jacks J^3 and J^4 . This trunk extends in two limbs 35 and 36 to the central office C^2 where it is provided with suitable means for testing the condition of the wanted subscriber's line, for ringing the desired subscriber and with signals to enable the operator to properly attend the connection. These trunk conductors 35 and 36 terminate at the incoming office in windings w' and w'' of the repeating coil W and the interposed condenser c^5 . A trunk relay r^7 of fairly low resistance is connected in a conductor, 80 leading from the trunk conductor 36 to the spring 81 carrying the back contact 82 of the grounded spring 42 of sleeve relay r^9 . The trunk conductor 35 is connected by means of a conductor 83 with the forward contact 84 of the said spring 81. Normally, therefore, the trunk relay r^7 is connected in a grounded branch from the trunk conductor 36, but upon the operation of the sleeve relay r^9 , it is connected in series between the two conductors 35 and 36 of the trunk through the medium of conductor 80, spring 81, contact 84 and conductor 83 and is therefore operated over the metallic trunk line. The opposite windings w^3 and w^4 of the repeating coil W with an interposed condenser c^5 are connected between the tip strand t^3 and the sleeve strand s^3 of the flexible end of the trunk circuit, said end being herein-after referred to as the trunk cord. These strands terminate in corresponding contacts p and p^2 of the trunk plug P^3 . The tip relay r^8 is located in a conductor 36^a leading from the tip strand through the battery B^3 to ground. The sleeve relay r^6 is legged directly to ground by conductor 41 from the sleeve strand s^3 of the trunk cord. These relays serve to control the signal circuits at the incoming end of the trunk so that the operator is enabled to properly attend the connection. These signal circuits comprise the battery lead 47 extending from the live pole of the battery, a conductor 85 including the ringing lamp S^4 and extending to the spring contact 51 of the sleeve relay r^9 , the normal contact 86 of which is connected by a conductor 87 to the point 88. A parallel branch of the signal circuit extends from the battery lead 47 over conductor 89 thence through the pilot relay r^{12} and the disconnect and guard lamp S^5 and thence to the spring contact 90 of the trunk relay r^7 , which is normally connected through its contact 91 with the point 88. From this point 88 a common conductor 92 leads to the forward contact 93 of the tip relay r^8 . An auxiliary branch of the signaling circuit is completed by a conductor 94 from the forward contact 95 of the trunk relay to the back contact 96 of the tip relay. It will thus be observed

that one parallel branch of the said circuit or circuits includes the ringing lamp S^4 and is controlled through the contacts 51 and 86 of the sleeve relay, while the other parallel branch includes the guard and disconnect signal S^5 and has its continuity controlled through the contacts 90 and 91 of the trunk relay r^7 . Moreover, the tip relay r^8 is enabled through contacts 37 and 93 to connect ground to the junction point 88 of these parallel branches. The auxiliary branch 94 is enabled to throw ground upon the parallel branch containing the guard and disconnect signal only when the trunk relay is operated. It will therefore be observed that whenever the sleeve relay is operated the ringing lamp circuit is open, that when the trunk relay is operated the disconnecting lamp circuit is open at the trunk relay r^7 but is closed upon the auxiliary branch 94. The operator at this end of the line is enabled to connect her telephone with the trunk cord by means of the key k^6 , k^6 , while the operator at the other exchange is enabled to connect her telephone with the B operator by means of the instruction circuit 33. A ringing generator g^2 is shown connected with the tip ringing contact k^4 , the resistance lamp being in circuit therewith, while the sleeve key k^4 is grounded as shown. The subscriber's line L^2 shown in connection with the office C^2 is of the type employing three or four wires and extending throughout the switchboard for the operation of the busy test and the cut-off relay. This line includes conductors 2 and 3 extending to the subscriber's station D, while the receiver 5 and transmitter 4 are included in series in the line when the telephone is off the hook, but when the telephone is upon the hook, the tip line conductor 2 is connected with the grounded signaling bell 6. In this instance the tip spring 10 of the cut-off relay R^3 is normally grounded while the sleeve spring 11 normally leads through the line annunciator S^7 which is connected by the conductor 47 to the live pole of the battery B^3 . When the cut-off relay is actuated, however, these springs are connected through their forward contacts 14 and 15 with the tip and sleeve contacts j and j^2 of the connecting jacks. A third contact 11^a is provided for the cut-off relay which is grounded through a resistance coil 11^b and the forward contact of which connects by conductor 11^c with the test rings j^4 , j^4 , of the jacks which are designed to be insulated from the line even when the plug is inserted. The jacks, themselves, are each provided with an additional contact j^3 which is grounded when a plug is inserted and is connected with one side of the cut-off relay R^3 , the other side of which is connected with the battery lead 47 whereby when the plug is inserted in the jack, current from the main battery B^3 flows through the cut-off relay R^3 to operate the same, to disconnect

the line signaling device and connect the line limbs to the main contacts of the jacks. J^5 , J^5 , and J^6 , J^6 , are respectively "busy back" and "don't answer" jacks associated with the incoming trunks. This apparatus comprises an induction coil 67 having its primary in circuit with the rapidly rotating circuit breaker 68 and the battery B^4 , this battery being preferably the same as battery B^3 but shown separately for convenience. The secondary of the induction-coil 67 is connected in circuit with the rapidly rotating interrupter 69 and the more slowly operating interrupter 70. From interrupter 69 a conductor 71 leads to the sleeve contacts of the busy back jacks J^5 , J^5 , through a 50 ohm resistance coil 72, while interrupter 70 is connected by conductor 73 through resistance-coil 74 to the sleeves of the don't answer jacks, J^6 , J^6 . The tips of both sets of jacks are united by conductor 75 with a grounded pole of the battery. The circuit breaker 68 causes induced currents in the secondary circuits which are interrupted at short intervals by breaker 69 and at longer intervals by breaker 70 to cause distinctive tones in the receiver of the waiting subscriber when the trunk plug is inserted in one or the other of the jacks. The circuit breakers 69 and 70 serve also to make and break the circuit of the supervisory relay r^9 whereby the supervisory signals at both ends of the trunk are flashed in accordance with the interrupted current.

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

The operation is as follows: The A subscriber wishing 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^1 through conductor 13, line relay R^2 , spring 11 of cut-off relay R , limb 3 of the telephone line, through the retardation coil 9 and transmitter 4 at the sub-station, and thence over limb 2 back to the central office and spring 10 of cut-off relay R through conductor 12 to ground. The line relay R^2 is thus operated and closes the circuit of the signal lamp S to ground from the conductor 13. The operator upon seeing the line signal exposed inserts the answering plug P into the answering jack J of the subscriber's line and connects her telephone 30 with the cord cir-

cuit by depressing the listening key k , k , to receive the order from the subscriber. The insertion of the plug P closes a circuit through the cut-off relay R from the live pole of the battery B' through conductor 17, sleeve supervisory relay r^3 , sleeve strand s , sleeve contacts p^2 and j^2 of the plug and jack, thence through the winding of the cut-off relay R to ground. The operation of this relay disconnects the armatures 10 and 11 from the ground wire 12 and from the battery lead 13 and connects them through the forward contacts 14 and 15 of said armatures to the normally disconnected jacks J, J².

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 S² 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 role of the battery B', as soon as the cut-off relay R is operated. The supervisory signal S² therefore remains inert while the battery B' furnishes current over the metallic telephone line for the operation of the supervisory relays and for conversational purposes. The operator's transmitter 28 is receiving current at this time from the battery B² over the conductor 26 through retardation coil 27, thence through the transmitter 28 and over conductor 29 to ground. When sound waves strike the transmitter 28, the current flowing therethrough is varied which causes a variation of the charge in the condenser c^3 and a corresponding surge of current through the primary of her induction coil 25. These induce voice currents in the secondary which are transmitted to the line and the operator is therefore able to converse with the calling subscriber. Upon learning that a subscriber in the exchange C² is desired, the A operator depresses the order key k^2 to connect her telephone with the order wire or circuit 33, and repeats the number of the wanted subscriber to the B operator whose head telephone 50 is permanently connected with the said order wire. The latter operator designates to the A operator the trunk to be used for the connection and proceeds to test the condition of the wanted line with the tip of the plug of the incoming trunk named. If the line is idle, no "click" will be received, but if busy, the test rings j^4 of the jacks will be connected to ground through the spring 11^a of the cut-off relay and resistance coil 11^b to ground. As before explained the tip of the testing plug is connected through the tip strand of the trunk cord, conductor 36^a, tip relay r^8 and battery B³ to ground. A complete circuit will therefore be established when the tip of the plug is

touched to the test ring of the busy line, which will cause a flow of current and will affect the receiver of the B operator, which is connected across the trunk cord circuit by means of the key k^6 , k^6 , sufficiently to indicate to her that the line is busy. On finding the line idle the plug P³ is inserted in one of the multiple jacks of the wanted subscriber's line. The A operator having received the number of the trunk to be used inserts the calling plug P² of her cord circuit in the trunk jack J³ at her section at substantially the same time that the trunk plug is connected with the called line. The insertion of the cord circuit plug P² closes a circuit from the live pole of the battery B² at the A office through conductor 19 sleeve supervisory relay r^5 sleeve strand s^2 of the cord circuit sleeve contact of the plug and jack and over the sleeve conductor 36 of the trunk to the central office C² thence through conductor 80 and the trunk relay r^7 over spring 81 and contacts 82 and 42 of the sleeve relay r^9 to ground. Current over this path actuates the sleeve supervisory relay r^5 in the A cord circuit which attracts its armatures and cuts out the test relay r^6 and completes the tip strand of the cord circuit through armature 20 and its forward contact 21. The supervisory signal S³ associated with the calling plug P² of the A cord circuit is therefore lighted by current from the live pole of the battery B² flowing over the conductor 26 and through the signal lamp S³ and the armatures of the two supervisory relays to ground. This lamp is therefore lighted and remains lighted until the response of the called subscriber as hereinafter explained. The trunk relay r^7 is also operated at this time by current over the path just traced which closes its contacts 90 and 95 and breaks contact 91 and would operate the disconnecting signal S⁵ except for the fact that the tip relay r^8 is now operated by current from the battery B³ over conductor 36^a through the said relay, the tip strand t^3 , the tip conductor 2 of the subscriber's line and through the grounded signaling bell 6. This relay therefore operates and closes circuit upon its forward contact 93 and since the sleeve relay r^9 is not yet operated, it completes the ground connection of the parallel signaling branches so that the ringing lamp S⁴, the continuity of whose circuit is controlled by the sleeve relay r^9 , is now lighted. Ringing current for the subscriber's line is furnished by the generator q^2 over the tip side of the line and through the bell 6, and should the subscriber respond during ringing, the current traverses back to the central office over the sleeve side of the line and through the grounded ringing key k^4 in the sleeve strand of the cord. When the subscriber responds a path for current from the battery B³ over the metallic line is provided through the tip relay and the tip strand of the cord, thence

over the tip line conductor and through the subscribers' instruments and back over the sleeve conductor of the line and the sleeve strand of the cord through conductor 41, the sleeve relay r^9 to ground and the other side of the battery. This current flows in sufficient quantity to also actuate the sleeve relay r^9 which opens its contacts 42 and 82 thus breaking the grounded-trunk-relay operating circuit and closing contacts 81 and 84, whereby the trunk relay is included in the metallic circuit of the outgoing end of the trunk and permits current to flow from the battery B^2 of the A cord over the metallic trunk and back to the A office thereby operating the supervisory relay r^4 connected with the A cord to open the circuit of the supervisory signal which indicates to the operator that the called subscriber has responded. Likewise the circuit of ringing lamp S^4 is opened at contacts 51 and 86 of the sleeve relay r^9 which indicates the same fact to the B operator. The subscribers are now in condition for conversation and all supervisory lamps are extinguished.

When the A subscriber returns his receiver to the hook, the supervisory lamp S^2 is lighted; and when the subscriber D hangs up his telephone, current is cut-off from the sleeve relay r^9 which permits the re-establishment of the conditions just described and serves to cut-off current from the supervisory relay r^4 at the A office whereby the supervisory signal S^2 is lighted. At the same time the ringing lamp S^4 is lighted at the B exchange. The A operator seeing both supervisory signals lighted withdraws the cord circuit which cuts off current from the trunk relay r^7 and permits it to close its contacts 90 and 91 whereby current is permitted to travel over the parallel signaling path through the pilot relay r^{12} and the disconnect lamp S^5 which is lighted, the pilot lamp S^6 being also lighted at the same time. The B operator is therefore informed that the connection has been taken down at the A exchange whereupon she withdraws the plug P^3 from the jack of the subscriber's line. This de-energizes the tip relay r^8 which disconnects the ground branch from the parallel signaling branches and retires all signals.

The disconnect lamp S^5 may be employed as a guard lamp in case a mistake is made and a trunk plug is inserted in the subscriber's line or in case the A operator connects with a wrong trunk. In the latter case, the trunk relay r^7 of the line is operated which closes the auxiliary branch 94 upon the parallel signaling branch containing the disconnecting lamp or guard lamp S^5 which is therefore lighted together with the pilot signal and indicates the fact of a mistake to the B operator.

The insertion of the plug P^3 in a jack of a line when a cord circuit is not connected

with the trunk at the opposite end results in establishing the disconnecting condition heretofore described, that is, the grounded branch 92 is closed upon both of the parallel signaling branches whereby both lamps S^4 and S^5 light.

In case the wanted subscriber's line is found busy or if a subscriber having been called does not respond, the plug P^3 is inserted in the jack J^5 or J^6 and a corresponding signal is transmitted to the waiting subscriber. Upon the insertion of plug P^3 in one of the busy back or don't answer jacks, for example, one of the jacks J^5 , a path for current is provided from the battery B^3 through the tip strand of the trunk cord, the tip contacts of the plug and jack and over conductor 75 to ground. This will serve to operate the tip relay r^8 to connect ground upon the parallel signaling branches. In the rotation of the circuit breaker 69 a path for current is also provided from the live pole of the battery B^4 over the secondary of the induction coil 67 and contacts of the circuit breaker 69 thence over the conductor 71 and the sleeve strand of the trunk cord through the sleeve relay r^9 to ground. This relay will therefore operate in accordance with the interrupted current to break the grounded circuit of the trunk conductor r^9 and complete its metallic circuit over both sides of the outgoing end of the trunk whereby the supervisory lamp S^3 at the A exchange is flashed in accordance with said interrupted current. The subscriber is simultaneously notified of the condition of the wanted line by the tone caused by the rapidly interrupted current.

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

Although I have described the method of making connections through the medium of the order circuit, I do not wish to so confine the invention for it is apparent that the A operator is able by means of her testing apparatus to test the condition of the several trunks before her until an idle trunk is found, and upon finding the same, she may connect the calling plug P^3 of her cord circuit with the trunk, which would operate the trunk relay r^7 at the incoming end and light the lamp S^5 which would then serve as a calling lamp. The B operator upon seeing the signal, would depress her listening key k^6 , k^a , and upon learning the order would make the desired connection, as hereinbefore described. It

will also be understood that had the A subscriber called for a connection with another subscriber in the same exchange, the line of that subscriber would have been tested in the ordinary manner by means of the cord plug P² and the subscriber would have been called by the ringing generator g.

In Fig. 2, I have shown a retardation coil 34 connected to the sleeve strand of the trunk at its outgoing end. In case of the use of such coil it would not be necessary for the contacts 81 and 84 at the B end of the trunk to make contact before breaking contact at points 82 and 42 as is necessary with the arrangement shown in Fig. 1, where, if the metallic circuit of the trunk be not completed before the ground circuit is opened, the sleeve supervisory relay in the A cord may become de-energized.

In case of ground currents which may flow in such strength as to operate the trunk relay when a retardation coil is employed at the outgoing end of the trunk, the device shown in Fig. 3 may be employed in which the retardation coil 34 is connected with a spring J³ of the trunk jack J³ which is normally disconnected from the sleeve conductor, but which, upon the insertion of the connecting plug is lifted by the tip spring into contact with the sleeve side. Under normal conditions therefore the retardation coil would be disconnected and earth currents could not affect the trunk relay. The ground connections hereinbefore referred to, it will be understood, may be and in practice usually are one and the same, or they may be the common office return, although it is found by experience that it is necessary to place a dead ground upon one side of the common battery which ground connection may be placed at the opposite pole of the several batteries instead of as shown in the diagram, all of which is apparent to those skilled in the art.

Having thus described my invention, what I claim 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 disconnect signal for the incoming end of the trunk, a source of current and a relay associated with the incoming end of the trunk, said relay being operated from said source over one side of the subscriber's line and ground at the sub-station when the connection is established with the line, to place the signal in condition to operate, and a second relay at said end responsive to current in the metallic circuit when the called subscriber responds for rendering said signal inoperative, substantially as described.

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

tions and adapted to connect telephone lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay actuated over the tip side of the talking circuit and ground adapted to direct current through said signal to operate the same when the subscriber has been called but before his response, and a second relay operated by current flowing over a portion of the talking circuit but having its coil out of the path of the voice currents, said relay being adapted to deprive said signal of operating current when the subscriber responds, 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 ringing signal for the incoming end of the trunk, a relay actuated over one side of the telephone line and through the grounded signaling bell to direct current through said signal to operate the same when the subscriber has been called, and a second relay at said end adapted to deprive said signal of operating current when the called subscriber responds, substantially as described.

4. The combination with a trunk circuit extending between different switchboard sections and adapted to connect lines together for conversation, of a ringing signal for the incoming end of the trunk, a relay and a source of current connected with the tip side of the trunk cord, a grounded signaling bell from the tip side of the subscriber's line, said relay being actuated by current from said source over the tip side of a cord and line and through the said grounded bell to cause the operation of said signal when the connection is established with the called line, and a second relay connected with sleeve strand of the trunk cord and responsive to current in the metallic line when the called subscriber answers, said latter relay serving to render said ringing 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 signal associated with the incoming end of the trunk, a relay also at the incoming end adapted to be operated by current sent over the trunk from the outgoing end, a second relay at said incoming end adapted to be operated by current flowing over one side of the called telephone line to the sub-station and ground when the connection is established with the said called line, said relays jointly controlling said signal so as to operate the same to give a guard indication when the connection is established at the outgoing end of the trunk and the trunk is disconnected from the called line, or to place said

signal in condition to operate so as to give a disconnect indication when the connection is severed at the outgoing end and is completed at the incoming end, 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 signal associated with the incoming end of the trunk, a relay also at the incoming end operated by current over a portion of the tip side of the talking circuit when the connection is established with the called line, a second relay at the incoming end actuated when the connection exists at the outgoing end, said relays jointly controlling said signal so as to operate the same to give a guard indication when the connection is established at the outgoing end of the trunk and severed at the incoming end, or to place said signal in condition to operate to give a disconnect indication when the connection is severed at the outgoing end and is completed at the incoming end, 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 guard signal for the incoming end of the trunk, means to actuate said signal by current sent over the trunk when the connection is established at the outgoing end of the trunk, and further means actuated by current sent over a portion of the talking circuit including one side of the telephone line to ground at the sub-station for rendering said signal inert, 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 guard signal for the incoming end of the trunk, a relay to place said signal in condition to operate and actuated by current sent over the trunk, and a relay actuated by current over a portion of the tip side of the talking circuit when connection is made with the called

line for rendering said signal inoperative, substantially as described.

9. The combination with a trunk line 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, a relay associated with the incoming end and connected with the sleeve strand of the trunk cord and responsive to current in the metallic talking circuit when the trunk is connected with the called line, a source of distinctive signaling current with which the incoming end of the trunk is connected when a subscriber is busy or fails to respond, means for intermittently operating said relay when the trunk is connected with said source, and means operated by said relay to correspondingly operate said supervisory signal, the waiting subscriber being also notified of the condition of the line by the distinctive tone in his receiver, substantially as described.

10. The combination with a trunk line 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, the outgoing end of the trunk being open to steady current and one side thereof connected to ground, said signal being placed in operative condition by current flowing over said side of the trunk circuit to ground, and a relay at the incoming end connected with the sleeve strand of the trunk cord actuated 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 to render the said supervisory signal inoperative, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 28 day of July 1902.

H. G. WEBSTER.

Witnesses:

ROBERT LEWIS AMES,
F. W. DUNBAR.