

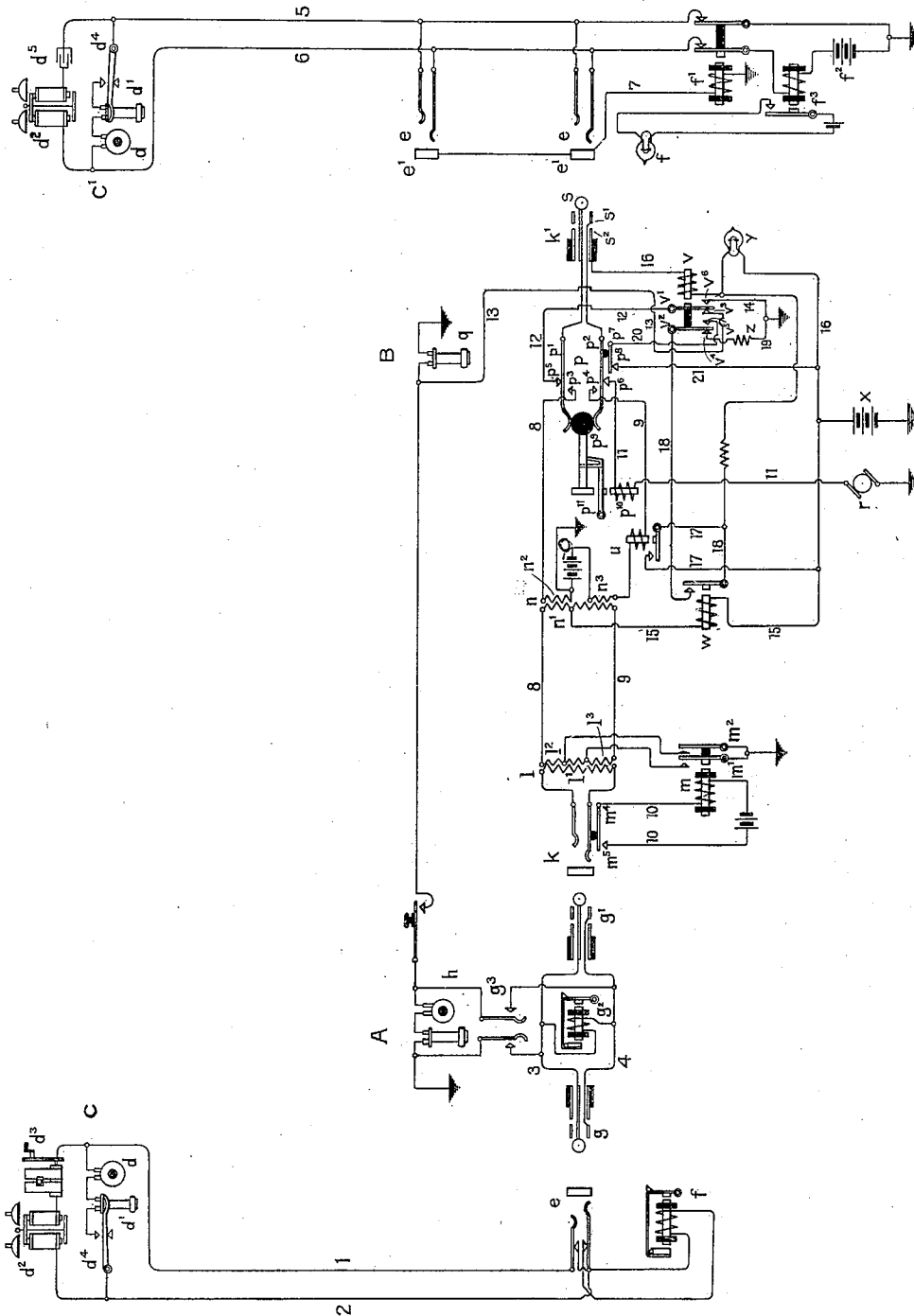
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C. E. SCRIBNER & F. R. McBERTY.
SIGNAL FOR TELEPHONE TRUNK LINES.

(Application filed May 21, 1898.)

(No Model.)



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UNITED STATES PATENT OFFICE.

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SIGNAL FOR TELEPHONE TRUNK-LINES.

SPECIFICATION forming part of Letters Patent No. 649,078, dated May 8, 1900.

Application filed May 21, 1898. Serial No. 681,288. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. SCRIBNER, residing at Chicago, in the county of Cook, and FRANK R. MCBERTY, residing at Downer's Grove, in the county of Du Page, State of Illinois, citizens of the United States, have invented a certain new and useful Improvement in Signals for Telephone Trunk-Lines, (Cases Nos. 470 and 66,) of which the following is a full, clear, concise, and exact description.

The invention concerns interoffice trunk-lines of telephone-exchange systems; and it consists in a scheme of signals for the incoming terminals of such trunk-lines to attain increased efficiency and reliability in the various operations involved in making connection between subscribers' lines by means of interoffice trunk-lines and in new and simplified mechanism for the operation of such signals.

Trunk-lines between offices of telephone-exchanges are commonly employed to extend connections from calling lines in a particular office to called lines in another office, the extension of connections in the reverse direction being accomplished by means of other groups of trunk-lines. The terminal of the trunk-line designed for connection with a calling-subscriber's line is commonly designated the "outgoing" terminal, and the operator who makes connection between the calling line and the trunk-line is known in this function as the "supervising" or A operator. The other terminal of the trunk-line, designed to be united with the line to the station called for, is named the "incoming" terminal, the operator having charge of that terminal being known as the "incoming" trunk or B operator. The functions of the A operator consist in answering the call of a calling line, making connection therefrom to the trunk-line, instructing the B operator to make connection from the trunk-line to the line called for, supervising the connection while it exists, and disconnecting the trunk-line from the subscriber's line when conversation is finished. The functions of the B operator consist in testing the line called for, assigning to the A operator the trunk to be used in

completing the connection, uniting the trunk-line with the line called for, ringing the bell at the called station, and breaking the connection of the trunk-line with the called line in response to suitable signals. It is essential to efficient operation on the part of the B operator that the latter be provided with a peremptory clearing-out signal controlled by both the called subscriber and the A operator.

The present invention applies particularly to trunk-lines whose incoming terminals are located in switchboards provided with automatic line-signals controlled incidentally in the use of the substation-telephones. The outgoing terminals of the same trunk-lines may be situated in switchboards having either such automatically-controlled signals or the usual annunciators. In general in exchange systems comprising both the so-called "magneto" lines and "automatic-signal" lines disconnection should be effected in response to the automatic signal in preference to that of the annunciator, inasmuch as the automatic signal is a certain indication of the discontinuance of conversation, while the operation of the annunciator results from a voluntary act on the part of a subscriber, which is frequently neglected. In following such practice, however, it is desirable that the disconnection-signal before the B operator be controlled both by the called subscriber and by the A operator, and, further, that a guard-signal be provided to prevent the reassignment of a trunk-line whose incoming terminal has been disconnected from a called line, while its outgoing terminal remains connected with the calling line.

The object of this invention is comprehensively to provide such clearing-out and guard signals for the B operator, together with such other signals as are desirable in meeting certain emergencies which arise in the process of making and supervising connections between lines, with mechanism for operating the signals, means for connecting and disconnecting the testing-telephone and for applying and withdrawing the calling current; and it consists in apparatus and simplified circuits whereby these ends are attained in a highly-efficient manner.

The invention is illustrated in the attached drawing, which represents two telephone-lines entering switchboards in different offices, a trunk-line between the switchboards, and means for making connection between either terminal of the trunk-line and the corresponding subscriber's line in the same office, the trunk-line being provided with our improved circuits and apparatus.

The office A is assumed to be the center of lines provided with annunciators for operation by means of magneto call-signals, while the office B forms the center of lines furnished with automatic signals and means for operating them. The apparatus at the substation C of office A comprises a transmitting-telephone d , a receiving-telephone d' ; a call-bell d^2 , a generator d^3 of calling-current, and a switch d^4 for connecting either the signaling apparatus or the telephones with the line-circuit. The line conductors 1 and 2 from these appliances are led to the line-contacts of a spring-jack e in the switchboard in office A, from which point they are normally extended to include an annunciator f . The switchboard is furnished with the usual pairs of connecting-plugs g and g' , united by a plug-circuit 3 4. With the plug-circuit are associated a clearing-out annunciator g^2 and a listening-key g^3 for connecting the operator's telephone h with the plug-circuit. The substation C' is likewise furnished with telephones d and d' , a call-bell d^2 , and a telephone-switch d^4 for closing the circuit through the telephones while the latter are in use. The call-bell is in a permanently-closed bridge of the line-circuit, which, however, is broken as respects continuous currents by condenser d^5 , interposed in it. Thus the circuit of the line is complete at the substation C' only while the telephone is in use. Line conductors 5 and 6 lead from this apparatus to the line-terminals of spring-jacks e in the switchboard, whence they are extended through the normally-closed switch-contacts of a cut-off relay f' to the poles of a calling-battery f^2 . A relay f^3 is interposed in conductor 6, which controls a secondary line-signal f , associated with one of the spring-jacks e . The magnet of the cut-off relay f' is located in a grounded conductor 7, which terminates in normally-open contact-pieces e' of the spring-jacks of the line.

The interoffice trunk-line 8 9 terminates at the office A in a spring-jack k , having contact parts adapted to cooperate with the plugs g' in the switchboard at that office to extend the plug-circuit 3 4 into union with the trunk-line 8 9. The trunk-line terminates at the B office in a plug k' , which is adapted for use with the spring-jacks e of lines in the switchboard at that office. The trunk-line is, however, not conductively continuous between these points. At the office A a repeating-coil l has its windings interposed in the trunk-line. The portions of the line leading to the spring-jack are permanently united through one winding l' . The outgoing portions of the

trunk-line are connected with terminals of two other windings l^2 and l^3 of the same repeating-coil, which, however, are normally open, being connected with switch-contacts of a relay m , whose contact-levers m' and m^2 are connected with earth. The controlling-magnet of this relay m forms part of a local battery-circuit 10, whose continuity is controlled by auxiliary switch-springs m^4 m^5 in the spring-jack k , which become closed together when a plug is inserted into the spring-jack. Thus normally the outgoing portions of the trunk-line 8 9 are open; but they become closed to earth when connection is made with the spring-jack k by means of plug g' through the agency of switch-contacts m^4 m^5 and relay m . At the incoming terminal of the trunk-line also a repeating-coil n breaks the conductive continuity of the line. The portions of the trunk-line going therefrom to office A are united through the winding n' of the repeating-coil. The portions leading to the plug k' are united through other windings n^2 n^3 , a battery o , having one pole grounded, being interposed in the circuit. The incoming terminal of the trunk-line is equipped with a key p for controlling the connection of the operator's telephone q with the trunk-line for testing purposes and of the generator r of calling current, the control of the key being partially manual and partially automatic. This key comprises two pairs of switch-springs p' and p^2 , each with normal contacts p^3 and p^4 and alternate contacts p^5 and p^6 , respectively, and an auxiliary switch-spring p^7 and its anvil p^8 , against which it is thrust while the springs p' and p^2 are in their alternate positions. These switch-springs may be thrust apart from their normal to their alternate positions by means of a wedge p^9 , carried on a suitable moving part. The return movement of this lever is, however, controlled by an electromagnet p^{10} , which when excited withdraws a catch p^{11} , engaging a lug on the movable part of the key. In associating this key with the circuit the lever p' is connected with the tip s of plug k' , while its normal resting-anvil p^3 is connected with the winding n^2 of the repeating-coil n . The lever p^2 is connected with the sleeve s' of plug k' , and its normal contact p^4 is connected with one terminal of winding n^3 of the repeating-coil. The alternate anvil p^6 of switch-spring p^2 forms the terminal of the grounded generator r of calling current, the magnet p^{10} being interposed in the circuit 11 between the generator and the spring. The contact-pieces p^7 p^8 control a portion of a local circuit which will be described presently. The key is so constructed that when the double wedge is thrust between the switch-springs p' p^2 by the movement of the push-button the lug on the push-rod is engaged by the catch carried on armature p^{11} , so that the switch-springs are held in their alternate positions until through the action of magnet p^{10} the lever is disengaged and the switch-springs are permitted

to press the wedge outward and to close on their normal resting-anvils.

A supervisory relay *u* for controlling a supervisory signal is interposed in conductor 9 of the trunk-line between the battery *o* and the plug *k'*, so as to be in the path of current from the battery to the station of the called subscriber. The supervisory relay controls a signal through the agency of another branch of the local circuit before referred to.

Each trunk-line is provided with a relay *v*, having two switch-levers *v'* and *v''*, with normal contact-anvils *v³* *v⁴*, respectively, and alternate anvils *v⁵* and *v⁶*. The lever *v'* is connected by wire 12 with the contact-anvil *p⁵*. The normal resting-anvil *v³* of the same switch-spring forms the terminal of a conductor 13, which includes the operator's receiving-telephone *g*. The alternate contact-anvil *v⁵* of this switch-spring is directly grounded by a wire 14. The other switch-contacts of the relay *v* are involved in the local circuit. A relay *w*, which is concerned in the display of the clearing-out signal at the B operator's position, has its magnet-winding interposed in a conductor 15, leading to the central point of the winding *n'* of repeating-coil *n* to the free pole of a battery *x*, which may in practice be identical with the battery *o*. The switch-contacts of this relay also control portions of the local circuit.

The local circuits referred to, which form a substantial feature of the present invention, are concerned in the operation of a supervisory lamp-signal *y*, being adapted to secure control of this signal by different appliances at different times, according to the condition of the different terminals of the trunk-line. The object of these local circuits is to cause the lamp *y* to be lighted when the relay *u* is inert, the key having been operated while the plug *k'* is in a spring-jack, so that during such time the signal *y* is controlled from the station of the called subscriber, but to place the signal *y* under the control of relay *w* to be lighted when the switch-contacts of that relay are closed, when the plug *k'* is withdrawn from the spring-jack, whereby the signal *y* becomes a guard-signal controlled by the A operator when the incoming terminal of the trunk-line is disconnected.

In a conductor 16, leading from the free pole of grounded battery *x* to the sleeve-contact *s²* of plug *k'*, the lamp-signal *y* and the magnet-winding of relay *v* are interposed serially. The supervisory relay *u* by means of its contact-points controls a shunt 17, including a resistance-coil. A conductor 18 leads from this shunt intermediate of the switch-contacts of the relay *u* and the resistance-coil therein to the switch-lever *v''* of relay *v*, the switch-contacts of relay *w* being interposed in the conductor. The resting-anvil *v⁴* of this switch-spring forms the terminal of grounded conductor 19, including a resistance-coil *z*, while the alternate anvil *v⁶* forms the terminal of a wire 20, leading to spring *p⁷* of

key *p*, the other contact of the pair being connected by wire 21 with the free pole of battery *x*. Thus the relay *v* acts with the circuit connections to provide in one case a grounded battery-circuit independent of the plug *k'*, in which current is controlled by the clearing-out relay *w* to light the lamp when the relay is closed and in another case to provide a circuit by way of the plug, assuming the existence of a connection therewith, wherein the lamp *y* is controlled by a shunt whose continuity is determined by relay *w*, the signal being displayed when the relay is inert. In co-operation with these agencies the supervisory relay *u* controls the lamp *y* jointly with the relay *w* and the key *p* during the existence of a connection. The purposes of these permutations of the circuit will be apparent in following the operation of the trunk-line.

In following the process of making and supervising a connection between telephone-lines by means of this apparatus a call must be assumed to originate with the subscriber at station C. The user of the telephone there, by operating his generator *d³*, excites the magnet of line-annunciator *f* and displays the indicator thereof to the operator at office A. This operator, by inserting plug *g* into the spring-jack *e* of the line and bringing her telephone *h* into connection with the plug-circuit 3 4, is enabled to communicate with the calling subscriber and learn his order for connection with station C', the line from which enters the office by depressing the order-wire key associated with her telephone B. The A operator then brings her telephone into the order-wire to office B, and, addressing the B operator, instructs her to make connection with line to station C'. The B operator, knowing that trunk-line 8 9 is free, instructs the A operator to make use of trunk-line 8 9 in extending the connection to the office B, whereupon the A operator inserts the other plug *g'* of the pair which she has taken for use into the terminal spring-jack *k* of the trunk-line designated. At the same time the B operator applies the tip *s* of plug *k'* to the test-ring of a spring-jack *e* of the line called for. If this line be in use, a battery will be found in connection with the test-circuit in accordance with well-known practice, and at each application of the tip of the plug to the test-ring of the spring-jack a current will flow therefrom by way of contacts *p' p⁵* of key *p*, conductor 12, contacts *v' v³*, and conductor 13, traversing the operator's telephone and producing therein the characteristic test sound. If the line be free, no such current will be produced and no such signal will result from the application of the testing-plug to the spring-jack. Finding the line open for use, the B operator inserts plug *k'* into the spring-jack *e* of the line called for. These acts on the part of the A and B operators place the apparatus in position to form a telephone-circuit between the stations C and C'. This circuit is not conductively complete, being interrupted at

the A office by the repeating-coil l and at the B office by the repeating-coil n , but the circuit is inductively continuous by way of these coils as respects telephone-current. The circuit going from the B office to the called station is, however, severed at the office last mentioned, its terminals being in effect applied to the poles of the generator r of calling current. Thus circuit may be traced from earth at the generator by way of wire 11, through magnet p^{10} , by switch-contacts $p^6 p^2$, a portion of conductor 9 of the trunk-circuit to line-wire 6, through the bell at station C', returning by the line-wire 5 through a portion of wire 8 of the trunk-line, through contacts $p' p^5$, by wire 12 to the relay v , and thence, in virtue of the altered condition of this relay, consequent on the establishment of connection, through wire 14 to earth. It will be observed that the introduction of plug k' into the spring-jack e closed a local circuit made up of wires 16 and 7, wherein current flowed from battery x to excite the relay v . The same current traverses the magnet-winding of the cut-off relay of the line with which connection is made, causing this appliance to sever the normal ground connections of the line. Thus the generator r is applied to the line to ring the bell at station C', the magnet p^{10} being in the circuit of the calling current. It will be observed that the excitement of relay v in applying the ground 14 to the wire 12 to form a return-circuit for the calling current at the same time disconnected the wire 13, containing the operator's telephone, so that the operator is free to attend to other connections. The normal path of current in the circuit 16 7 is through the lamp y , but this lamp is now shunted by a circuit which may be traced through wire 21, contacts $p^7 p^8$, wire 20, contacts $v^5 v^2$, and wire 18. This shunt is controlled by the relay w , whose contacts in tracing this circuit have been assumed to be closed. The excitement of the relay w is consequent on the insertion of plug g' into the spring-jack k at the office A. By such insertion the local circuit of relay m is closed at switch-springs $m^4 m^5$ of the spring-jack, the relay is excited, and the conductors 8 and 9 are connected together and to earth. The completion of these circuits furnishes a path for current from battery x through relay w by way of wire 15 and thence through conductors 8 and 9 to ground at the A office. Observing the condition of the apparatus at this stage, it will be seen that the bell at station C' is being rung. The signal-lamp y , which represents the line for purposes of supervision to the B operator, is dark, but its illumination is controlled by the A operator through the agency of relay w . If for any reason—as, for example, on account of the failure of the called subscriber to respond to the call—the A operator should disconnect the plug g' from the trunk-line, the local circuit of the relay m at the A office would be broken

and the relay w would be deprived of current, whereupon the shunt about lamp y would be broken and this lamp would be lighted. This would constitute a disconnection-signal to the B operator, who would accordingly remove the plug k' from the spring-jack of the called line. In ordinary circumstances, however, the called subscriber will respond to the call by removing the telephone from its switch, whereby the closure of the line-circuit will be brought about. The completion of the circuit at the station effects a great increase in the current flowing from generator r , whereby the magnet p^{10} of key p is excited and releases the switch-lever of the key. The switch-springs $p' p^2$ are thus permitted to sever their connection with their alternate contact-anvils, which form the terminals of the calling-generator, and to close upon their normal resting-anvils, whereby the breaks in the trunk-circuit are closed. The circuit is then in condition for telephonic communication, being complete as respects telephonic currents between the terminal substations. The release of key p permits the contact-points $p^7 p^8$ to separate, whereby the shunt of lamp y , controlled by the relay w , is broken, to remain in this condition through the remainder of the existence of the connection. At the same moment, however, current flows from battery o through supervisory relay u to the called station, where the circuit is closed, and the relay u assumes control of lamp y , closing the shunt 17 about the lamp. The appliances have now reached their normal condition for conversation. Neither operator gives any further attention to the connection until the call for disconnection is received. Such a call will be sent from the office C by the operation of the generator there, which will actuate the clearing-out annunciator g^2 at office A. The equivalent act at substation C' consists in the replacement of the telephone on its switch-hook, whereby the circuit of battery o is broken and the relay u is deprived of current. When the supervisory relay u becomes inert, it breaks the shunt 17 about lamp y and brings about the illumination of the lamp.

As before stated, the most advantageous practice in the conduct of trunked connections is found in disconnecting the trunk-line at the B office in response to the display of the supervisory lamp y at that office. In accordance with this practice the B operator, on observing the illumination of lamp y and knowing that the plug k' is in a spring-jack, will withdraw the plug from the spring-jack and replace it in its normal seat in the switch-board in proximity to the lamp y . This act deprives the relay v of current, whereby the connection of wire 18 with wire 20 is broken and a new connection is formed with grounded conductor 19. A new circuit is thus formed through the lamp y from battery x by way of wire 16, thence through wires 18 and 19, to earth. Current in this circuit is controlled

by the relay *w* independent of all other appliances with a reverse mode of control to that formerly exercised—namely, the current exists and the lamp *y* remains lighted while the relay is excited. Thus the lamp *y* remains lighted until the A operator withdraws plug *g'* from spring-jack *k*. Thus after the disconnection of the incoming terminal of the trunk-line from the called line the lamp *y* remains displayed before the B operator to guard against a reassignment of the trunk-line for the extension of another connection, while the previous connection still exists at the office A. Thus the lamp *y* is under the control of the A operator to serve as a call or disconnection-signal while the calling current is being transmitted to the called station. It is a supervisory or clearing-out signal controlled by the called party after his response to the call. It is a guard-signal to prevent the reassignment of the trunk after the disconnection of the incoming terminal.

It will be apparent that the mechanism and operation of this invention as applied to the B terminal of the trunk-line are independent of the nature of the switching apparatus at the A office. It is merely necessary that means be provided for exciting the relay *w* from the A office in consonance with the formation or removal of connection with the outgoing terminal of the trunk-line.

The invention is defined in the following claims:

1. The combination with a telephone trunk-line between A and B terminal stations, of a visible signal at the B station and a relay controlled from the A station, different circuits including switch-contacts of the said relay and the visible signal, one of said circuits being adapted to permit the flow of current through the signal when the relay is excited and the other being adapted to prevent the flow of current through the signal when the relay is excited, and a switch controlling both said circuits to make either operative, as described.

2. The combination with a telephone trunk-line between A and B terminal stations, a signal at the B station and a relay, with means for exciting the relay from the A station, two circuits of the signal, both circuits including switch-contacts of said relay, one circuit being adapted to cause a flow of current through the signal when the relay is excited and the other circuit being adapted to prevent such flow when the relay is excited, a switch controlling both said circuits to make either operative, and means for actuating the switch in making connection between the B terminal of the trunk-line and a called-subscriber's line, as described.

3. The combination with a telephone trunk-line between A and B terminal stations, a relay at the B terminal and a circuit thereof controlled by switch-contacts at the A terminal operated in making connection with

the line, a signal at the B terminal, and two circuits of said signal, one of said circuits including serially the signal and the switch-contacts of the relay, and the other of said circuits consisting of a closed circuit of the signal and a shunt of the signal controlled by the same contacts of the relay, a switch controlling the said circuits to make either operative, and means for actuating the switch in making connection with the B terminal of the trunk-line, as described.

4. The combination with a telephone trunk-line and means for making connection with the terminals thereof, of a signal at the incoming terminal of the trunk-line, a relay for controlling the signal, and means for exciting the relay in making connection with the outgoing terminal of the trunk-line, a local circuit normally including the switch-contacts of the relay and the said signal in series, a device made operative in making connection with the incoming terminal of the trunk-line adapted to bring the switch-contacts of the said relay into shunt of the signal; whereby the mode of control of the relay over the signal is reversed in making connection with the incoming terminal of the trunk-line, as described.

5. The combination with a trunk-line and means for connecting the telephone-lines with the terminals thereof, of a signal at the incoming terminal of the trunk-line, a relay having its magnet in a circuit closed in making connection with the outgoing terminal of the trunk-line, a local circuit of the signal normally including the switch-contacts of the relay, an electromagnetic switch and circuit connections thereof adapted to break the normal connection of said relay-contacts with the local signal-circuit and bring the said contacts into shunt of the signal, and a circuit including an actuating-magnet of the said switch closed in making connection between a telephone-line and the incoming terminal of the trunk-line, as described.

6. The combination with a telephone trunk-line at the incoming terminal thereof, of a signal and relay controlled from the outgoing terminal of the trunk-line, a local circuit including the signal, and means for closing it in making connection with the incoming terminal of the trunk-line, a shunt about said signal controlled by the switch-contacts of the relay, an electromagnetic switch having its actuating-magnet in the said local circuit, said switch being adapted when inert to break the shunt of the signal and to form a circuit including the signal and the switch-contacts of said relay in series, as described.

7. The combination with a telephone trunk-line at the incoming terminal thereof, of a key for applying calling current to the line with which the said terminal is connected, and a magnet responsive to changes in the current flowing in the line controlling said key, a signal associated with the trunk-line, a relay and means for controlling it from the outgoing

terminal in making connection with the line, circuit connections of the said relay with the signal, whereby the relay determines current in the signal, and switch-contacts of the calling key closed during the transmission of calling current to render said circuit connections operative; whereby the signal is controlled from the outgoing terminal of the trunk-line during the transmission of calling current at the incoming terminal thereof, as described.

8. The combination with a telephone trunk-line at the incoming terminal thereof, of a supervisory relay responsive to currents in the line determined in the use of the substation-telephone, when the said incoming terminal is connected with the line, a signal for the trunk-line, a relay and means for controlling it automatically in making connection with the outgoing terminal of the trunk-line, and circuit connections of the signal with the said last-mentioned relay and the supervisory relay, both said relays being adapted to control current in said signal independently, as described.

9. In combination with telephone-lines and an interoffice trunk-line, a key for applying calling current to the called line through the agency of the incoming terminal of the trunk-line, and a magnet in the path of the calling current adapted to trip the said key, an operator's testing instrument, an electromagnetic switch and means for exciting it in mak-

ing connection between the incoming terminal of the trunk-line and the called line, said switch being adapted to disconnect the telephone from the testing-contact of the terminal plug of the trunk-line; a signal associated with the trunk-line, a circuit therefor containing a battery normally closed at one point in switch-contacts of the said electromagnetic switch, a relay controlling a second break in the circuit of the signal, the said relay being controlled by current determined in making connection with the outgoing terminal of the trunk-line; a normally-open shunt of the signal controlled by said electromagnetic switch, said switch being adapted to break the normal ground-circuit of the signal and connect the said shunt of the signal when the actuating-magnet of the switch is excited, said shunt having two breaks, one of which is controlled by said relay and the other of which is controlled by auxiliary contacts of the calling-key closed during the transmission of calling current; a supervisory relay in the path of current to the called line, and a shunt of the signal controlled by said supervisory relay, substantially as described.

In witness whereof we hereunto subscribe our names this 11th day of April, A. D. 1898.

CHARLES E. SCRIBNER.

FRANK R. MCBERTY.

Witnesses:

ELLA EDLER,

DUNCAN E. WILLETT.