

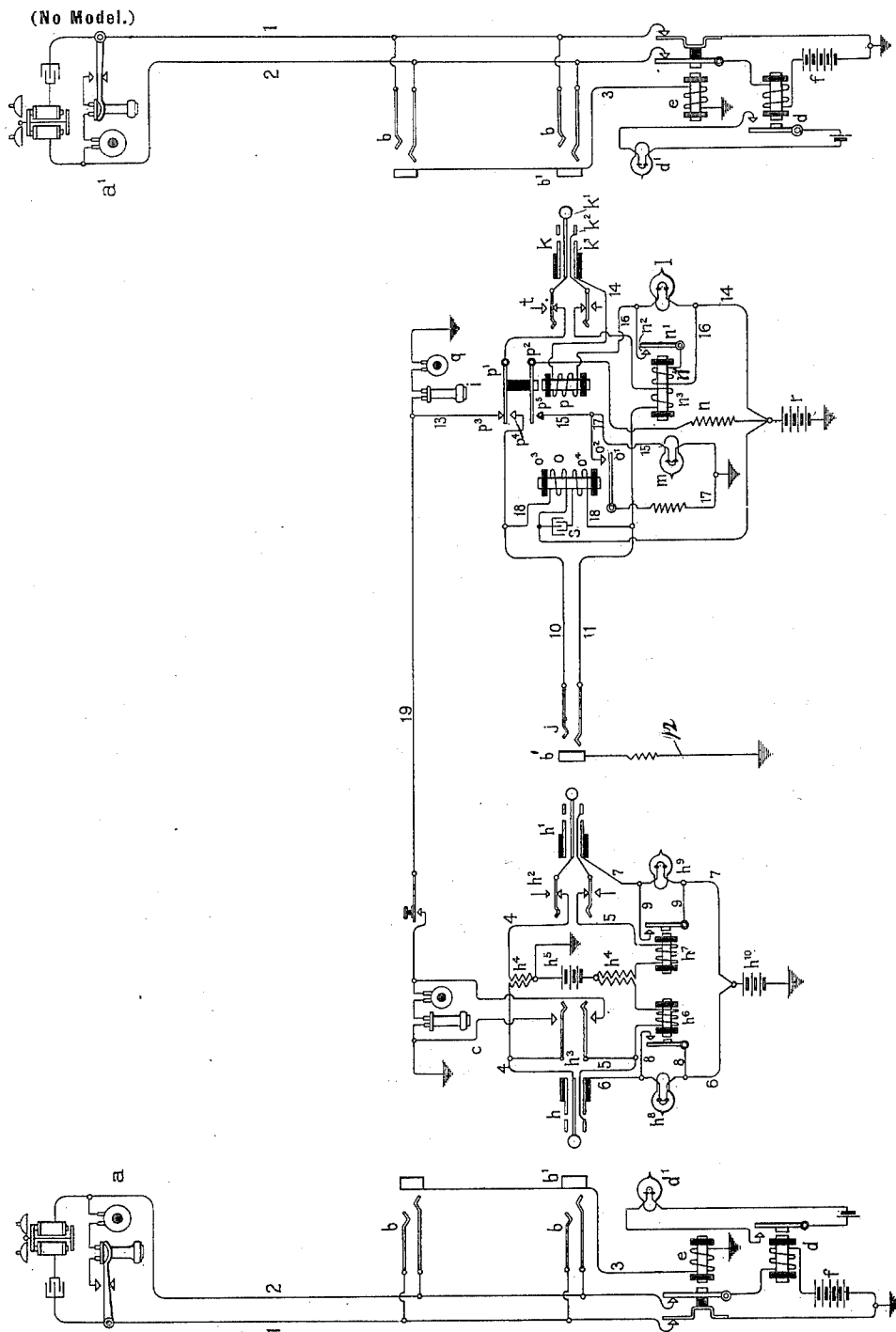
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C. E. SCRIBNER.

SIGNAL FOR TRUNK LINES OF TELEPHONE SYSTEMS.

(Application filed June 17, 1898.)



Witnesses:

S. A. Danner
George L. Crapp

Inventor:

Charles E. Scribner,

by

Carton & Brown his Attys

UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE
WESTERN ELECTRIC COMPANY, OF SAME PLACE.

SIGNAL FOR TRUNK-LINES OF TELEPHONE SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 649,959, dated May 22, 1900.

Application filed June 17, 1898. Serial No. 683,742. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Signals for Trunk-Lines of Telephone Systems, (Case No. 468,) of which the following is a full, clear, concise, and exact description.

10 This invention applies to trunk-lines between central offices of telephone-exchange systems.

15 It consists in a system of visible signals, with means for operating them to enable the attendant at one terminal station of the trunk-line to make, supervise, and remove connections between the trunk-line and subscribers' lines with a high degree of efficiency and with a slight liability to error.

20 In the employment of trunk-lines between offices of extensive exchanges the greatest efficiency is attainable in using any trunk-line to extend connections in only one direction—that is, from the office within which the 25 calls originate to that wherein the connections are to be completed—business in the reverse direction being accommodated by trunk-lines assigned solely for such connections.

30 The terminal of the trunk-line with which connection is made from the line of a subscriber calling is frequently referred to as the "originating" or "A" terminal, the attendant who makes the connection being termed the "A" operator. The other extremity of the 35 trunk-line, which is employed in completing the connection to the line of the party called, is designated the "incoming" or "B" terminal and the attendant the "B" operator. The functions of the A operator consist in answering the call of the calling subscriber, 40 making connection with the trunk-line, instructing the B operator to make the connection between a trunk-line and the line called for, supervising the connection while it exists, and removing the connection at the A 45 terminal in response to the subscriber's call for disconnection. The functions of the B operator consist in assigning to the A operator the trunk-line which is to be used, testing the line called for, making connection 50 with the line, sending the call-signal to the

station thereof, and removing the connection of the trunk-line with the line of the called subscriber in response to a signal from the A operator. The agencies employed by the A operator consist of the apparatus by means of which she makes ordinary connections; but the apparatus at the B terminal of the trunk-line is of a special nature designed to give the B operator the special information 60 which she requires. This apparatus is so constructed, however, as to permit the operation of the apparatus at the A terminal in its usual manner in order that the A operator may not be confused in her work by a multiplicity of signals with different meanings. 65

The mechanism and signals at the B terminal of the trunk-line should perform the following functions: The mechanism should provide a circuit by means of which the operator may test the line to determine whether it be free for use. A signal should be provided to indicate the response of the called party to the call-signal; but this signal should not be again displayed during the connection. 70 A signal should be displayed when the A operator breaks the connection with the trunk-line; but this signal should be so arranged that the called subscriber can attract the attention of the B operator in the event of accidental disconnection at the A switchboard. 80

The present invention is addressed to these various requirements and is adapted for use in connection with means for automatically controlling the different signals referring to 85 the telephone-lines automatically in the use of the terminal telephones. Its principal features consist in the combination, with a subscriber's line with means for determining the flow of current in the line in the use of the telephone and a trunk-line for temporary association with the subscriber's line, of a testing-telephone at the B terminal, an electromagnetic switch for connecting the telephone with a test-contact of the plug, and a 90 circuit for operating the switch to disconnect the telephone when connection is made with the line, a signal referring to the line of the called party, means for controlling it in response to currents in the called line determined in the use of the telephone, and a device for preventing the display of the signal 95 100

after the response of the called party, a clearing-out signal, a relay associated with the trunk-line, means for producing current through the relay, and circuit connections forming two paths for current therein, one controlled by a switch at the A terminal of the trunk-line and the other controlled at the station of the called line.

A further feature of the invention consists in an improved construction and mode of arrangement of the relay for controlling the clearing-out signal, whereby the static balance of the trunk-line is maintained.

The invention is shown diagrammatically in the attached drawing. This drawing represents two telephone-substations with lines entering switchboards in different central offices, a trunk-line between the offices, and signaling mechanism in accordance with the present invention associated with the trunk-line.

For the purpose of controlling signals the circuits through the call-bells at the stations *a* and *a'* are interrupted, as respects continuous currents, by condensers interposed in the conductors. Thus the line-circuits are placed in condition to permit the flow of a steady current through them only when the telephones are taken from their switches for use. In other respects the equipment at the substations is of usual and well-known character. From station *a* line conductors 1 and 2 lead to spring-jacks *b* in a switchboard at the central office *c*. Associated with the same line are a relay *d*, with a secondary line-signal *d'* controlled by it, and a cut-off relay *e*. Both conductors of the line-circuit are prolonged from the spring-jack through the switch-contacts of the cut-off relay, after which they are united through a battery *f*, the magnet-winding of relay *d* being included in the line conductor 2. The magnet of cut-off relay *e* is located in a grounded conductor 3, which leads to normally-insulated contact-rings *b'* of the spring-jacks *b*. The switchboard is furnished with the usual pairs of plugs *h* and *h'*, together with the conductors 4 and 5, uniting them, constituting the plug-circuit, and the usual calling key *h²* and listening-key *h³*. The conductive continuity of the plug-circuit is interrupted by the interposition therein of a repeating-coil *h⁴*, two serially-connected windings of the repeating-coil being located in each conductor of the plug-circuit, with a bridge uniting the points of junction of the pairs of windings. In this bridge of the plug-circuit a battery *h⁵* is interposed. In the portion of the conductor 5 at each side of the bridge a relay is placed, these relays being designated *h⁶* and *h⁷*, respectively, whose function is to control signal-lamps *h⁸* *h⁹*, respectively, referring to the different lines with which plugs *h* and *h'* may become connected. The lamps are in the circuit of conductors 6 and 7, respectively, which terminate in sleeve-contacts of plugs *h* and *h'*, designed to register with the con-

tact-rings *b'* of the spring-jacks into which they may be inserted, their other terminals being led to the free pole of a grounded battery *h¹⁰*. Relays *h⁶* and *h⁷* control the current through the lamps *h⁸* and *h⁹*, respectively, through the agency of shunts 8 and 9, including the switch-contacts of the relays.

A trunk-line 10 11 extends from the office *c* to the office *i*, wherein the line from station *a'* terminates. This trunk-line is designed to be used in making connections from calling lines in the office *c* to lines called for in the office *i*. The conductors of the line terminate in contact-pieces of a spring-jack *j* before the A operator at the office *c*, similar in arrangement and function to the spring-jacks of a subscriber's line. The contact-ring *b'* of this jack forms the terminal of a conductor which includes a coil of resistance equal to that of the magnet-winding of relay *e*. At its other terminal in office *i* the conductors of the trunk-line are completed during the use of the line to the line-contacts of a plug *k*. Signal-lamps *l* and *m* are associated with this terminal plug, the former designed to serve as a line-signal referring to the line of a called party and the latter as a clearing-out signal. The circuits of these signals, together with other circuits associated with the trunk-line, are controlled by three relays *n*, *o*, *p*, respectively. The relay *n* has a single pair of switch-contacts *n'* *n²*, which become closed when the relay is excited, but its magnet is provided with two windings *n³* and *n⁴*. The relay *o* is of somewhat similar construction, having also a single pair of switch-contacts *o'* and *o²* and two magnet-windings *o³* and *o⁴*. The relay *p* is provided with two switch-springs *p'* and *p²*, which are actuated by the armature. The former of these has a normal resting-contact *p³* and an alternate contact *p⁴*, against which it is thrust when the relay is excited, while the latter spring has only an alternate contact *p⁵*. The switch-contacts *p'* *p³* control the continuity of one conductor of the trunk-line extending to the tip *k'* of plug *k*, the tip of the plug being connected with the switch-spring *p'* and the line conductor 10 being led to the anvil *p⁴*. The normal resting-anvil *p³* of the switch-spring forms the terminal of a conductor 13 in the circuit of the telephone *q* of the B operator. The magnet of relay *p* and the signal-lamp *l* are included serially in a conductor 14, which leads from a battery *r* to the local contact-piece *k³* of plug *k*. The switch-spring *p²* is connected with the free pole of the same grounded battery, and its contact-anvil *p⁵* forms the terminal of a grounded conductor 15, which includes the signal-lamp *m*. The conductor leading from the battery to the switch-contact *p²* contains a resistance-coil. This coil may have a resistance approximately equal to that of the lamp *m*.

The conductor 11 of the trunk-line is normally continuous to the sleeve-contact *k²* of plug *k*; but it traverses one winding *n³* of re-

lay n . The other winding n^4 of this relay, together with the switch-contacts $n' n^2$, which the magnet controls, are interposed in a conductor 16, which is designed to form a shunt about the lamp l .

The windings $o^3 o^4$ of the relay o are located in a bridge 18 of the trunk-circuit 10 11, together with a condenser s . This bridge is connected with the free pole of battery r .

The switch-contacts $o' o^3$ of this relay control a wire 17, which when it is closed forms a shunt about the signal-lamp m . The purpose of providing two windings on the relay o in a completed bridge of the circuit with a condenser interposed between the windings is to maintain the static balance of the trunk-line while retaining an operative connection of the relay with the line. The windings of the relay should be of many turns to attain high impedance in the magnet.

The circuit of the line conductors to the plug k traverses the switch-contacts of the usual calling-key t for bringing a generator of calling-current into circuit with the plug.

Communication may be established between the telephones of the A and B operators by means of an order-wire 19, which permanently includes the receiving-telephone of the B operator at office i , but which may be brought into connection with the telephone of the A operator through the agency of a key under the control of the latter operator.

In the operation of this system the mere removal of the telephone from its switch at station a for use brings about the display of the line-signal d' , and thus indicates a call to the operator at office c . In response to this call the operator will insert plug h into a spring-jack b of the calling line, at the same time bringing her telephone into connection with the plug-circuit, and thus through oral communication will learn the subscriber's order—say for connection with station a' entering the office i . The insertion of a plug into the spring-jack of a calling line completes a local circuit 6 3 of battery h^{10} , whereby the cut-off relay e is excited and breaks the normal ground connections of the calling line. At the same time the circuit completed from battery h^5 through the conductors of the plug-circuit effects the excitement of relay h^6 , which closes the shunt 8 about the lamp h^9 . Having learned the order of the calling subscriber, the A operator brings her transmitting-telephone into circuit with the order-wire 19 and addressing the B operator at the office c instructs this operator to make connection with the line to station a' . The B operator, observing that the trunk-line 10 11 is free for use, informs the A operator that this trunk-line will be used in making connection, whereupon the A operator inserts plug h' into the spring-jack j . This act of the A operator completes a local circuit 7 12 of battery h^{10} , by which the lamp h^9 is lighted. The battery h^5 finds as yet no circuit through the conductor 5 of the plug-

circuit and the conductor 11 of the trunk-line, so that the shunt about lamp h^9 remains broken and the lamp continues to be lighted. While the A operator is completing her portion of the work of making connection between the lines, the B operator, taking the plug k , tests the line to station a' by applying the tip of plug k to the test-ring b' of a spring-jack of the line called for. If this line be in use in virtue of a connection already existing with the line, a battery h^{10} or r will be connected with the test-rings of these spring-jacks and a current will flow to the tip of the plug and thence through the conductor 13 to earth, producing a characteristic test-sound in the telephone of the B operator. If the line be not in use, no such current will result from the application of the plug to the spring-jack. Finding the line free for use, the B operator inserts the plug into the spring-jack of the line called for and transmits a calling current to the station thereof by means of the key t . Putting the plug k into the spring-jack b closes the local circuit of battery r through conductors 14 and 3, whereby the relay p and the lamp l are excited. The magnetization of the relay-magnet brings the switch-springs $p^1 p^2$ against their respective anvils $p^4 p^5$, whereby the conductor 10 of the trunk-line is made continuous to the tip-contact of the plug k , and thus to conductor 1 of the line-circuit, while the connection of the tip of the plug with the operator's telephone q is broken and a local circuit is closed by way of wire 15, which provides current for exciting the signal-lamp m . The current in signal-lamp l lights this lamp, whose display indicates to the B operator that the line-circuit at the station called is open. The insertion of plug h' into the spring-jack j at office c provides a path for current from battery r through winding o^3 of relay o , through the conductor 10 of the trunk-line, and through a portion of conductor 4 of the plug-circuit to earth, whereby the relay o is excited and is caused to complete the shunt 17 about the lamp m . Hence when this clearing-out lamp m becomes connected with an exciting-battery r it is shunted through the instrumentality of relay o and remains dark. When the called subscriber, responding to the signal, takes his telephone for use, the line-circuit becomes closed at the substation, current flows from battery h^5 through a portion of conductor 5 of the plug-circuit, conductor 11 of the trunk-line, and conductor 2 of the line-circuit, returning by way of line conductor 1, trunk-line conductor 10, and conductor 4 of the plug-circuit. The current in this circuit excites both relays h' and n at the offices c and i , respectively. The magnetization of the former relay brings about the completion of shunt 9 about supervisory signal-lamp h^9 , whereby the A operator is informed of the response of the called subscriber. The magnetization of relay n effects the closure of shunt 16 of super-

visory lamp *l*, darkening this lamp, and at the same time provides a closed local circuit including the winding n^1 of the relay *n*, whereby the relay is prevented from subsequent control by current through the trunk-line. Hence the signal-lamp *l* will remain dark while the connection exists. The purpose of the lamp *l* is to permit the B operator to send a second or subsequent call-signal to the called station if the first signal should receive no response or in the event of obtaining no response to inform the A operator that the called party cannot be made to answer. When this condition has been reached, the stations *a* and *a'* are in telephonic communication. The supervisory lamps h^8 and h^9 in the switchboard at office *c* are dark, and thus indicate that the telephones at the terminal substations are in use. The lamps *l* and *m* before the B operator indicate to her, respectively, that the party called for has responded and that connection with the trunk-line remains at the office *c*. The replacement of the telephone on its switch at either station *a* or *a'* affects only the signals h^8 and h^9 , the return of either telephone to its switch being indicated by the lighting of the corresponding signal. When both signals have become illuminated, the A operator may assume that the conversation has been finished and may withdraw plugs *h* and *h'* from the spring-jacks into which they are inserted. The withdrawal of plug *h'* from the spring-jack *j* breaks the circuit of battery *r* through the conductors 10 and 4, and since the circuit from battery *r* through the telephone-line is already broken the relay *o* is deprived of current and breaks the shunt 17 about the clearing-out lamp *m*. This lamp then receives current from battery *r*, which lights it, and its display instructs the B operator to remove the terminal plug of the trunk-line from the spring-jack into which it is inserted. Its removal breaks the circuit through relays *n* and *p*, whereby all the apparatus and signals are permitted to return to their normal conditions.

The invention is defined in the following claims:

1. The combination with two telephone-lines, each provided with means at its station for controlling a current in the line automatically in the use of the telephone, said lines terminating in different offices, of a trunk-line between the offices uniting the said subscribers' lines, a source of current at one of the offices in a bridge of the united circuits, an electromagnet at the other office in the path of current therefrom to the line entering the said office, and a supervisory signal controlled by the magnet, as described.

2. In combination with telephone-lines, each having at its station a switch for controlling a current in the line in the use of the

telephone, said lines entering different offices, of a trunk-line uniting the telephone-lines, a bridge of the united circuits and a source of current therein at the originating office, an electromagnet in the path of current therefrom to the called line at each of said offices, one of said magnets being located at each office, and a supervisory signal controlled by each of said electromagnets, as described.

3. The combination with telephone-lines having telephone-switches at their substations controlling currents in the line in the use of the telephones, said lines entering different offices, of a trunk-line uniting the said lines, a bridge of the united circuits at the originating office and a source of current therein, an electromagnet in the path of current therefrom to the calling line, two electromagnets in the paths of current therefrom to the called line, said last-mentioned magnets being located at the different offices, and supervisory signals controlled by each of the electromagnets, as described.

4. The combination with telephone-lines and means at the stations thereof for controlling currents in the lines in the use of the telephones, said lines entering different offices, of a trunk-line uniting the lines, a bridge of the completed circuit and a source of current therein, an electromagnet in the path of current to the calling line, two electromagnets, located at the different offices, in the path of current to the called line, a local circuit of the electromagnet at the B terminal of the trunk-line including a winding of the electromagnet there, together with switch-contacts closed by the said magnet when excited, means for closing the local circuit at another point in the use of the trunk-line, and supervisory signals controlled by the magnets at the different offices; whereby the supervisory signals at the A office indicate at all times the position of the telephones at the substations, while the supervisory signal at the B office is controlled from the called substation only when the telephone is brought into use, as described.

5. The combination with a trunk-line for uniting telephone-lines entering different offices, of an electromagnet having two windings connected in a bridge of the trunk-line, a condenser interposed between the said windings, a source of current connected to one of the windings, and a clearing-out signal controlled by the electromagnet, whereby the balance of the line as respects inductive disturbances is maintained, as described.

In witness whereof I hereunto subscribe my name this 2d day of April, A. D. 1898.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,
MYRTA F. GREEN.