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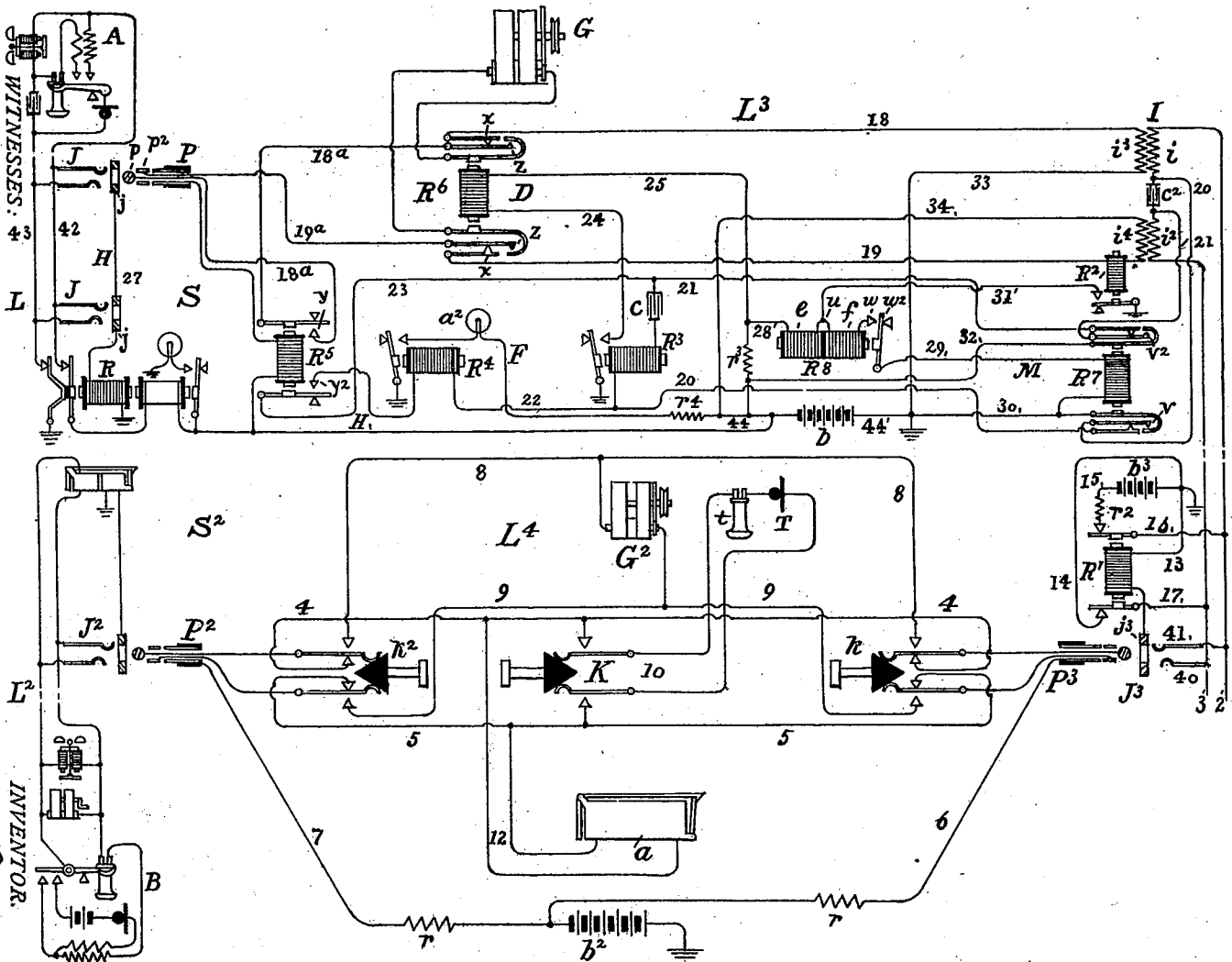
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M. C. RORTY.

TELEPHONE EXCHANGE CIRCUIT AND SIGNALING APPARATUS.

(No Model.)

(Application filed Oct. 4, 1900.)



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TELEPHONE-EXCHANGE CIRCUIT AND SIGNALING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 666,698, dated January 29, 1901.

Application filed October 4, 1900. Serial No. 32,027. (No model.)

To all whom it may concern:

Be it known that I, MALCOLM C. RORTY, residing at Dedham, in the county of Norfolk and State of Massachusetts, have invented certain Improvements in Telephone-Exchange Circuits and Signaling Apparatus, of which the following is a specification.

This invention relates to telephone-exchange circuits and to switching and signaling apparatus therefor, and particularly concerns the signaling appliances and operations employed in connections made by means of trunk conductors between substation-circuits normally connecting with different central stations.

The object of the present invention is three-fold—first, to enable both substations of two united by a trunk-line, even though one of them be provided with automatic calling devices responsive to the act of taking the receiving-telephone from its hook and the other with manually-operated appliances, such as an ordinary magneto-call generator, to operate one and the same supervisory or disconnecting signal placed at one end of said trunk; second, to enable the withdrawal of a switch-plug at one end of the trunk-line, in obedience to the operation of the said supervisory signal and as the initial step in the disestablishment of the through-communication circuit, to automatically operate a signal upon the switchboard at the other end of said trunk, whereby the operator there may be notified to take the further action necessary to complete disestablishment, and, third, in combination with a trunk-line and its accessories adapted to the attainment of the first and second objects above mentioned, to enable an operator located at one end of the trunk-line (whereby through communication is to be established between two substation-circuits connecting with different switchboards) to signal the substation of the circuit united to the other or distant end of said trunk-line. In pursuance of these objects when two substation-lines entering different central stations (or even different switchboards at the same central station) are united by a double conductor-trunk extending between the two switchboards concerned and a regular switch-

cord connection preferably at that end of the trunk connected with the called-for line the active signaling appliances of the trunk-line are mainly associated or grouped at that end of said trunk which is adapted for connection with the circuit of the substation initiating the call, and as this end of the trunk conductors is usually fitted with a switch-plug attachment it will be found convenient to term it the "switch-plug" end of the trunk, and as the other end of the trunk conductors is usually fitted with switch-socket attachments it may be termed the "switch-socket" or "socket" end, or, since it is also the place where the toll operator presiding over a through connection is stationed, it may alternatively be called the "toll-board" end.

I provide a supervisory relay associated with the trunk and conductively in circuit therewith and with the circuit of the call-initiating substation. This relay is responsive to the motions of the switch-hook at the said substation, being excited when, relieved from the weight of the receiver, the said hook is in its upper position and remaining unexcited while the receiver is on its hook. It is combined with a special slow-acting relay and a separator relay or electromagnet switch or signaling-key controlling the relation of terminal contacts of the trunk-line and terminal contacts of a source of current in such a way that when on the conclusion of a conversation the substation-telephone is restored to its hook the combined action of the supervisory relay and the slow-acting relay enables the electromagnetic switch or key to become operative and to momentarily connect the said source of current with the trunk-line and to cause current to flow over the said trunk-line. An ordinary electromagnetic disconnecting signal-receiving device, such as an annunciator, is bridged between the switch-cord conductors at the toll-board or switch-socket end of the trunk and, actuated by the said current, operates in response to the replacement of the telephone at the substation whose circuit is united with the plug end of the trunk, and the toll operator may then disconnect the lines concerned or connect telephones with them to find out if anything more is wanted.

The disconnecting process thus begins at the toll-board end of the trunk.

To provide means for indicating to an operator at the "plug" end of the trunk that disconnection there may now be made and that such disconnection has, in fact, been initiated at the socket end thereof, a relay at the said socket end is made to control the connection with the trunk-line of a source of current and is itself in a local circuit controlled by a circuit-changer associated with the trunk-line switch-socket and the switch-cord plug belonging thereto in such a way that when said plug is in its socket the relay operates to switch current from the trunk-line, and when the said plug is withdrawn the current is switched to the trunk-line, and if said line is closed at its distant end through appropriate apparatus the said apparatus may be made operative. Such apparatus at the plug end of the trunk comprises a visible signal (preferably a lamp) in a local circuit controlled by a relay in the before-mentioned trunk-line extension-loop. The said loop is closed through contacts of a separate electromagnetic switch or double contact-relay, which relay is excited to maintain by its contacts the continuity of such loop as long as the trunk-line at its plug end is switched to the calling-circuit. Thus the relay in the loop is responsive to the withdrawal of the plug from the socket at the socket end of the trunk-line and becoming excited operates the visual signal. When the trunk-plug is withdrawn from the substation line-jack in obedience to the said signal, the loop is opened by the double contact-relay controlling it and the signal disappears. Furthermore, in order to provide, in combination with circuit arrangements and signaling appliances and apparatus, as above set forth, means whereby the operator at one end of the trunk-line may signal the substation of the circuit united to the other end of said trunk-line the switch-cord at one end of the trunk-line has a manual ringing-key associated with it and adapted to send alternating currents over the trunk-line, and at the distant end of said trunk a relay responsive to alternating currents is placed in series with a condenser in an extension-loop thereof. This relay when excited by the alternating currents incoming over the trunk-line actuates an electromagnetic or automatic ringing-key at its own end of said trunk, which key thereupon is enabled to transmit a second set of alternating call-currents to the substation which is to be signaled, so that the action of the toll or other operator stationed at a switchboard at one end of a trunk-line brings about the operation of an automatic ringing-key acting directly upon the substation-circuit united to the other end of said trunk-line, and thereby actuates the call-signal at the substation of said circuit.

The drawing accompanying this specifica-

tion is a conventional diagram of the circuits of a telephone-exchange system containing and illustrating all of the several phases or features of the invention.

L represents the circuit of a substation A and extends therefrom to a central station S. It is constructed and organized on the central-battery plan, being provided at both stations with the well-known switching, signaling, and telephone apparatus appropriate to that system of operation. It has branch terminal jacks or switch-sockets J, provided with conducting test-rings or socket-frames *j*, electrically united to one another and through a cut-off relay R to ground, so that in a manner well understood a switch-plug having two main conductors and one local conductor may when inserted in said jack make connection with the two jack-springs, and thus change the main circuit, and may connect a grounded source of current to the frame-piece *j*, and thus through the agency of the cut-off relay disconnect the normal terminal apparatus.

L² represents a substation-circuit of the older type extending from a substation B, where it is provided with a local transmitter-battery and a bridged call-generator to a central station S², where as a call-receiving device it has an annunciator and the usual branch terminal switch socket or sockets J². The annunciator is of the self-setting variety and has a magnetizing-coil in circuit with the jack frame-piece in the usual way for the performance of the resetting operation. This substation-circuit L² may or may not pass through an intermediate central station; but in any case we may regard the jack J² as being the switching-terminal of the circuit at a toll-station of the system.

The entire lower portion of the drawing represents the toll-station or the central station S², to which the substation-line L² and a sufficient number of trunk-lines entering from other central stations converge, and L³ represents one such trunk-circuit extending between the central station S, where it terminates in the switch-plug P, and the central station S², where it terminates in the switch-socket J³, of which there may be any necessary number. Connections initiated by the substation-circuits L centering at the central station S and to be made with lines centering elsewhere are completed through the agency of such trunk-circuits. The trunk-circuit L³ ends at the central station S in a switch-cord circuit with which all of the station apparatus of the trunk is associated, the plug P forming the switch-terminal of such cord. A portion of the conductors 2 and 3 is represented by broken lines to indicate the line portion of the trunk-circuit. That portion of the apparatus associated with the trunk-circuit, shown as placed between said broken lines and the plug P, is therefore located at the central station S, while such associated apparatus as is located between the

said broken lines and the end of the trunk-circuit at the central or toll station S^2 is placed at such central station S^2 .

L^4 is the switch-cord of the operator at central station S^2 and has terminal switch-plugs P^2 and P^3 .

When connection is established between the substation A of circuit L and the substation B of circuit L^2 , the plug P is placed within the jack J and the plugs P^2 and P^3 in the jacks J^2 and J^3 , respectively.

At central station S^2 , associated with the switch-cord L^4 , are the call-generator G^2 , ringing-keys k^2 , associated with the plugs P^2 and P^3 , respectively, supervisory transmitting and receiving telephones T t, and a key K to bridge said telephones between the main cord conductors, a battery b^3 , and a bridged electromagnetic disconnecting or supervisory signal a.

The tip conducting-surfaces of the plugs P^2 and P^3 are united by the conductor 4, and the forward-sleeve conducting-surfaces of said plugs are similarly united by conductor 5, both of the said conductors passing through separable contacts of the call-keys k^2 . From the rear-sleeve conducting-surface of the said plugs, respectively, conductors 6 and 7 extend to one pole of the battery b^2 , the other pole of which is grounded. Resistance-coils r of appropriate magnitude may be placed in the circuit of the conductors 6 and 7. Conductors 8 and 9 pass to each ringing-key from the poles of the generator G^2 . A loop 10 leads from the telephones to the listening-key K to form a closed bridge when the said key is pressed, and 12 is the bridge containing the signal a.

Associated with the switch-socket end of the trunk-circuit at central station S^2 is the circuit-changing relay R', having its exciting-coil in a conductor 13, leading from the frame-piece j^3 of socket J^3 to ground. This relay controls the connection of the battery b^3 with the trunk-circuit, the two poles of said battery being united by conductors 14 15 to fixed contacts, and the main conductors 2 and 3 of the trunk respectively united by branches 16 and 17 to cooperating movable contacts of the said relay. Thus when the electromagnet of the relay is excited the contacts are separated and the battery is disconnected from the trunk, and when such excitement ceases the contacts are again brought together and the current of the source may flow over the trunk conductors. Obviously the said relay is excited when the plug P^3 is inserted in the jack J^3 , because then the cord conductor 6, extending from the pole of battery b^2 , becomes grounded through the rear-sleeve contact of the plug P^3 , which registers with the socket-frame j^3 , and through the conductor 13 and the relay-coils. It is also apparent to persons skilled in the art that one battery b^2 alone may by a slight and obvious rearrangement of conductors be made to take the place of the two which for facility of illustration I have

shown, and it is also evident that I am not restricted to batteries, but that any suitable source of steady current may take the place of the batteries b^2 b^3 .

The apparatus which at the central station S is associated with the trunk-circuit will now be described.

I is a repeating induction-coil having two windings i i^2 (with a condenser c^2 between them) placed in the line-section of the trunk-circuit and connecting with the main conductors 2 3 thereof and having two corresponding windings i^3 i^4 placed in the office or cord section of the trunk-circuit to connect at their outer terminals with the main cord conductors 18 and 19, which lead ultimately to the tip and forward-sleeve conducting-surfaces p and p^2 of the switch-plug P. This repeating-coil divides the trunk-circuit at central station S into two conductive sections, one of which, placed, as it is, between the terminal-plug P and the repeating-coil, may properly be termed the "terminal-section," while the other, located between the said repeating-coil and the distant switchboard, is termed the "line-section."

R^2 is a supervisory signal-relay in conductor 19 of the talking-circuit.

R^3 is a circuit-changing alternating-current relay connected in series with condenser c in a loop formed by the conductors 20 21, leading from the two sides of condenser c^2 . The said loop is therefore an inductively-complete loop of the trunk conductors 2 and 3. The relay R^3 by its armature and fixed local points controls the continuity of a local circuit D of a battery or like source of current b , which local circuit is formed of the conductors 24 and 25 and contains the actuating-electromagnet of an automatic ringing-key R^6 and, if desired, a suitable resistance r^3 . The automatic ringing-key is associated with the main-line cord conductors 18 and 19 and with a call-generator G in such manner that when said key is quiescent the said main conductors are closed through separable resting contacts x thereof and that when the same is active the main conductors are severed at the contacts x , and the portions of both, 18^a and 19^a, leading toward the plug are brought into connection at the points z with the terminals of the generator G.

R^4 is a signal-controlling relay in an extension through conductors 22 23 of the trunk-loop, extending by conductors 20 and 21 between the windings i i^2 of the repeating-coil I, and its function is to control another local circuit F of the source b , extending therefrom through the resistance r^4 and the local-relay points to ground at the relay-armature and containing the lamp-signal a^2 .

R^5 is a circuit-changing relay or electromagnetic switch having its electromagnet in the local circuit H of the source, which circuit when the plug P is inserted in the socket J includes the cut-off relay R. This circuit H, beginning at the battery-terminal ground

and including the battery, is traceable by conductor 26 to the said magnet of relay R^5 , and then by the rear-sleeve conductor p^3 of the switch-plug, the socket-frame registering therewith, conductor 27, and cut-off relay R to an earth connection. The circuits acted upon by the relay-switch R^5 are two in number, the said relay-switch having two sets of armature-contacts for this purpose. One of these sets y is in the conductor 18^a of the main talking-circuit, and its fixed and movable members are united respectively to the plug-tip conductor p and through the automatic ringing-key to winding i of the repeating-coil. The circuit governed by the relay-contacts y^2 is the extension-loop circuit containing the signal-relay R^4 . The said extension-loop is therefore conductively closed, so that the relay R^4 may respond to a steady current as soon as the relay-switch R^5 operates, and at the same time the main-circuit conductor 18 or 18^a which normally is open at the contact y is closed. The operation of the said relay-switch on which both of these changes depend is of course brought about by the closure of the cut-off-relay circuit H consequent upon the insertion of the plug P, which insertion not only causes an extension of the two conductors of the substation-circuit L through the cord conductors 18 18^a and 19 19^a , but also by closing the local circuit H causes the normal gap at contact y in conductor 18^a to be closed, making said substation-circuit conductively continuous to the repeating-coil I.

R^7 also is a circuit-changing relay or electromagnetic switch or signaling key whose structure and arrangement of local-circuit-changing points resemble those of the automatic ringing-key R^6 . The magnet of this relay switch or key R^7 is connected in a normally open circuit M of the source b , which circuit has conductors 28, 29, and 30 and includes the coils e and f and the local contact-points w and w^2 of a differentially-wound slow-acting relay, presently to be described. The relay signaling-key R^7 has a shunt-circuit, which when closed prevents it from operating, the said shunt being formed of the conductor 31, extending from a point u between the two coils of the said slow-acting relay to the contacts of the supervisory relay R^2 and when these are closed to earth. The normal arrangement of the circuit-changing points v and v^2 of the relay-switch R^7 maintains the continuity of the trunk loop conductors 20 and 21, respectively, the armature of said relay-switch remaining unattracted; but on the excitation of the magnet thereof, and the consequent attraction of the armatures, these conductors are severed, and the ends of both leading outward through the repeating-coil windings i and i^2 , respectively, are made to temporarily connect with conductors 30 and 32, and thereby with the two poles of the source of current b .

R^8 is the differentially-wound slow-acting

relay hereinbefore mentioned. Its coils e f , though opposed, are in series with one another, the rear coil e alone, however, being initially in the circuit, which under such conditions leads from the grounded battery b through the resistance r^3 and conductor 28 to the said coil e , and then by the point u , shunt-conductor 31, and the contacts of the relay R^2 back to earth. When, however, the armature of the differential relay R^8 is attracted by the excitation of the rear coil e and an additional earth or return conductor provided by the contact thus made between the relay-points w and w^2 , the front coil f is introduced into the circuit of said return-conductor, which from the point u is traceable through coil f , points w and w^2 , conductor 29, magnet of relay-switch R^7 , and conductor 30 to earth. No appreciable current, however, passes this way as long as the armature of the supervisory relay R^2 remains attracted, the second coil f of the relay R^8 , together with the coil of relay-switch R^7 , being shunted by conductor 31.

From the inner end of the repeating-coil winding i^4 conductor 34 is extended to one pole of the source of current b , and from the inner terminal of winding i^3 of said repeating-coil the conductor 33 extends to the other pole of said source.

In the most approved toll-line telephone-exchange practice the call-initiating subscriber after giving the call replaces his telephone on the hook and gives the matter no further concern until he in turn receives a call to apprise him that all is ready. Referring again to the drawings, let it be assumed that substation A has made such a call for substation B, that the toll-operator at the switchboard at central or toll station S^2 has the call in charge, that the trunk-circuit L^3 has been assigned as the link between the two central stations or switchboards in the line of communication, and that the operator at S has connected the said trunk-circuit with substation-line L by inserting the terminal plug P thereof in the jack J of such circuit. The operator at S^2 unites the trunk and the circuit L^2 of substation B (or any intermediate line already connected therewith) by means of the cord-circuit L^4 , inserting the plugs P^2 P^3 into switch-sockets J^2 J^3 , respectively, and then rings both substations. The operation of key k^2 sends a call to substation B by connecting the line thereof directly with generator G^2 ; but there being no direct conductive connection between central station S^2 and substation A the calling of this substation is a more complex operation. The key k is depressed and transmits the alternating current of generator G^2 to the central station S over a path which may thus be traced: from one pole of said generator through conductor 8, key k , tip of plug P^3 , jack-spring 40, trunk-conductor 3, repeating-coil winding i^2 , conductor 21, including the resting contacts v^2 of relay-switch R^7 , and

condenser *c*, to the alternating-current relay R^3 , the return-path being by way of conductor 20, including the relay-switch contacts *v*, repeating-coil winding *i*, main trunk-conductor 2, jack-spring 41, the forward sleeve-conductor of plug P^3 , key *k*, and conductor 9 to the other generator-pole. This ringing-current operates the alternating-current relay R^3 , which controls the local circuit D at station S, wherein is included the electromagnet of the automatic ringing-key R^6 , and thus brings the said automatic key into action. Since prior to the operation of ringing the main cord conductor 18^a, normally broken in the contacts *y* of the circuit-changing relay R^5 , has been made continuous by the operation of that relay pursuant to the insertion of the trunk-plug P in the jack J, and the consequent closure of the local circuit H, the ringing-current of the generator G is transmitted by the automatic ringing-key R^6 over the substation-circuit L, the bell at substation A being thus brought under the control of the key *k* at the toll-board and arranged to be rung by the action of the operator there. Conversely, it is desirable that the supervisory signal at the toll-board shall be responsive to the hanging up of the telephone at substation A, as well as to the usual ring-off produced by the manual operation of the call-generator at the substation B on the close of a communication. My invention provides as follows for this desideratum: At substation A the telephone is taken from the hook-switch in response to the call given in the manner described. A section of the main talking-circuit is thus closed from said substation through the source *b* of current-supply, as follows: from one pole of said source by conductors 44 and 34, repeating-coil winding *i*⁴, supervisory relay R^2 , conductor 19, resting contacts *x* of ringing-key R^6 , conductor 19^a, contact-surface *p*³ of plug P, the corresponding spring of jack J, main conductor 42 of the substation-circuit L, the substation-telephone, main conductor 43, the shorter spring of jack J, tip *p* of plug, conductor 18^a, including contact *y* of relay R^5 , the resting contacts *x* of ringing-key R^6 , conductor 18, repeating-coil winding *i*³, and conductor 33 to the other pole of battery *b*. In the talking-circuit section thus constituted the variations of current produced by the operation of the transmitter at A propagate themselves over the trunk-line L^3 through the agency of the repeating-coil I in a well-understood manner. As relay R^2 is in the battery-circuit thus traced, it is obviously responsive to the hook-switch at substation A, which controls the continuity of the said circuit and becomes a supervisory relay. Accordingly as the circuit closes the said relay operates, attracting its armature, and thereby closing a local circuit of battery *b* and permitting current to flow from said battery through conductor 44, resistance r^3 , conductor 28, rear winding of differential relay R^8 , point *u*, conductor 3, and contact-points of supervisory relay R^2 . The consequent operation of the relay R^8 , resulting in the attraction of its armature and the establishment of contact between the points *w* and *w*², manifestly closes an alternative continuation-circuit for the rear coil *e* from the point *u* by way of the forward coil *f* of the said differential relay R^8 , the points *w* *w*², conductor 29, and the magnet-coils of relay-switch R^7 ; but no appreciable current for the present flows this way, the magnet-coil *f* and that of relay R^7 being shunted by conductor 31, which has a resistance so low as to be negligible, and the circuit remains in this condition during communication between substations A and B. This communication being finished, A replaces his telephone on the hook and the battery-circuit through relay R^2 is broken. The armature of said relay is promptly retracted and breaks the circuit through the shunt-conductor 31. The front coil *f* of relay R^8 and the magnet of relay-switch R^7 are thus brought actively into the circuit of the rear coil *e*, and the current of such circuit excites the said relay-switch R^7 . As has been stated, the two coils of the relay R are wound or connected in opposition, the relay being thus made differential. It also is a relay having an armature possessing considerable mechanical inertia or by any of the well-known plans of construction made slow in its retracting movements, which slowness is accentuated by the conditions under which in this invention the magnetic excitation of the cores is neutralized; but the removal of the shunt-conductor, causing the coil *f* to exercise magnetizing power on the core equal but opposite to that exercised by the coil *e*, does establish demagnetizing conditions, and the armature after a certain interval of time, readily to be predetermined within certain limits by the adjustment of the relay falls away, thus opening the circuit of the battery through the electromagnet of the relay-switch R^7 . The said relay-switch has, however, been active during the interval which has elapsed between the time of breaking the shunt 31 and the retraction of the armature of relay R^8 and by such activity has changed its contacts *v* and *v*² in such a manner as to transfer the extension-conductors 20 and 21 of the outgoing trunk-circuit from their normal connections to a direct connection with the two poles, respectively, of the battery *b*. A current from the said source is thus enabled to traverse the said trunk-circuit and to operate the bridged electromagnetic signal *a* in the cord-circuit L^4 at central station S², the said signal by these means being responsive to the telephone-switch at substation A. Obviously the same signal is also responsive to the call-generator at substation B, and either substation is thus enabled to ring off. The disconnecting-signal being thus received at that end of the trunk which is at central station S² it becomes necessary to give the operator at S like information in order that dis-

connection may promptly be effected there also. This is accomplished in the following manner: The insertion at central station S² of the plug P³ in jack J³ brings about the operation of relay R', for a current from battery b² under these conditions flows through resistance r, conductor 6, the rear sleeve conductor of plug P³, socket-frame of jack J³, magnet of relay R', and conductor 13 to ground. The armatures of said relay being thus attracted, the battery b³, otherwise in connection with the trunk-line conductors 2 and 3 by branches 16 and 17, is disconnected therefrom, and during the pendency of a communication no current from the said battery flows out over the trunk-circuit. When, however, in obedience to the operation of signal a the operator at S² withdraws the plug P³ from socket J³, the relay R' ceases to attract its armatures, which are retracted to their back-stops, bringing the trunk-conductor branches into contact with the poles, respectively, of the battery b³. Current now flows over the trunk-line, passing by way of resistance r², branch 16, main conductor 2, repeating-coil winding i, conductor 20, including resting contacts v of relay-switch R⁷, conductor 22, magnet of signal-relay R⁴, closed contacts y² of relay-switch R⁵, conductor 23, conductor 21, including the resting contacts v² of relay-switch R⁷, main trunk-conductor 3, branch 17, and conductor 14 to the other pole of the battery. The signal-relay R⁴ is thus brought into action and closes the circuit F, operating the signal a². Observing the said signal the operator at S withdraws the plug P, and all of the apparatus returns to its normal condition.

Having thus described the invention and its operation, I claim—

1. The combination in a telephone-exchange system, with a trunk-circuit extending between central-station switchboards S and S², and divided by an induction-coil at switchboard S into a terminal section including a source of current, and a conductively-separated line-section; a substation-circuit united to the terminal section of said trunk; a telephone-support switch actuated by the removal and replacement of the telephone at the substation of said circuit, controlling the continuity of said circuit and of the trunk-terminal section united thereto; a switch-cord connection united to said trunk at switchboard S²; and an electromagnetic signaling device bridged between the conductors of said switch-cord; of an electromagnetic switch or signaling key at switchboard S controlling the relation of terminal contacts of the line-section of said trunk-line and terminal contacts of a source of signaling-current; a supervisory relay in the terminal section of said trunk at switchboard S responsive to the operation of said substation-switch; a shunt-circuit established around the actuating-magnet of said electromagnetic switch or key by said supervisory relay when

the said switch is in its working position; and a slow-acting relay also at switchboard S controlled by said supervisory relay and cooperating therewith, to maintain said shunt, and after the disestablishment thereof, to temporarily maintain the circuit of said signaling-key magnet, and thereafter to break the same; whereby the replacement of the telephone at a substation at one end of said trunk-circuit may cause the operation of a supervisory signal at the other; as set forth.

2. In a telephone system the combination of a trunk-circuit extending between two central stations, and terminating at one of them in a switch-plug, and at the other in a switch-socket; with a signal in a local circuit; and a relay controlling the same, in the trunk-circuit, at the plug end thereof; and with apparatus at the socket end of said trunk, comprising a source of current; a relay controlling a connection between the two poles thereof, and the two main conductors of the said trunk-circuit, and adapted when excited to disestablish the said connection, and when unexcited to establish the same; a local circuit containing the electromagnet of said relay; and a switch-cord terminal-plug cooperating with the switch-socket of said trunk, and adapted when inserted therein to unite registering severed contacts of said local circuit, and when withdrawn therefrom to reestablish the separation of said contacts; whereby the withdrawal of the plug at the socket end of said trunk is enabled to operate the signal at the plug end thereof; substantially as and for the purpose specified.

3. In a telephone-exchange system, a trunk line or circuit extending between two central-station switchboards S and S², and divided by an induction-coil at switchboard S into a terminal section including a source of current and a conductively-separated line-section; a switch-cord connection associated with said trunk-line at switchboard S²; a substation-circuit associated with said trunk-line at switchboard S' and including an electromagnetic call-bell at the substation thereof; a telephone-support switch actuated by the removal and replacement of the telephone at the substation of said circuit and controlling the continuity of said circuit and of the trunk-terminal section united thereto; an electromagnetic signaling device bridged between the conductors of said switchboard; an electromagnetic switch or signaling key at switchboard S controlling the relation of terminal contacts of the line-section of said trunk-line with terminal contacts of a source of signaling-current; a supervisory relay in the terminal section of said trunk-line at switchboard S responsive to the operation of said substation-switch; a shunt-circuit established around the actuating-magnet of said electromagnetic switch or key by said supervisory relay when said switch is in its working position; and a slow-acting relay also at switchboard S controlled by said supervisory

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 5 to break the same; whereby the replacement
 of the telephone at a substation at one end
 of said trunk-circuit may cause the opera-
 tion of the supervisory signal at the other;
 a manual ringing-key associated with said
 10 switch-cord at switchboard S²; a relay in said
 trunk-circuit at switchboard S responsive to
 the operation of said key; and an automatic
 ringing-key associated with said trunk-cir-
 cuit also at switchboard S, actuated by an
 15 electromagnet in a local circuit responsive to
 the operation of said relay, and adapted to
 transmit ringing-current over the said sub-
 station-circuit for the operation of the sub-
 station-bell thereof.

20 4. In a telephone-exchange system, a trunk
 line or circuit extending between two central-
 station switchboards S and S² and terminat-
 ing at switchboard S in a switch-plug and at
 switchboard S² in a switch-socket; a switch-
 25 cord connection associated with said trunk-
 line at switchboard S²; a substation-circuit
 associated with said trunk-line at switch-
 board S' and including an electromagnetic
 call-bell at the substation thereof; a signal in
 30 a local circuit; a relay in the trunk-circuit at
 the plug end thereof controlling said local cir-
 cuit; apparatus at the socket end of the trunk
 comprising a source of current, a relay control-

ling connections between two poles of said
 source and the two main conductors of said 35
 trunk-circuit, said relay being adapted when
 excited to disestablish said connection and
 when unexcited to establish the same; a local
 circuit containing the electromagnet of said
 relay; a switch-cord-terminal plug cooperating 40
 with the switch-socket of said trunk and
 adapted when inserted therein to unite regis-
 tering contacts of said local circuit, and when
 withdrawn therefrom to reestablish the separa-
 45 tion of said contacts; whereby the with-
 drawal of the plug at the socket end of said
 trunk is enabled to operate the signal at the
 plug end thereof; a manual ringing-key asso-
 ciated with said switch-cord at switchboard
 S²; a relay in said trunk-circuit at the switch-
 50 board S responsive to the operation of said
 key; and an automatic ringing-key, asso-
 ciated with said trunk-circuit also at switch-
 board S, actuated by an electromagnet in a
 local circuit responsive to the operation of 55
 said relay, and adapted to transmit ring-
 ing-currents over the said substation-circuit for
 the operation of the substation-bell.

In testimony whereof I have signed my
 name to this specification, in the presence of 60
 two subscribing witnesses, this 2d day of Oc-
 tober, 1900.

MALCOLM C. RORTY.

Witnesses:

GEO. WILLIS PIERCE,
 JOSEPH A. GATELY.