

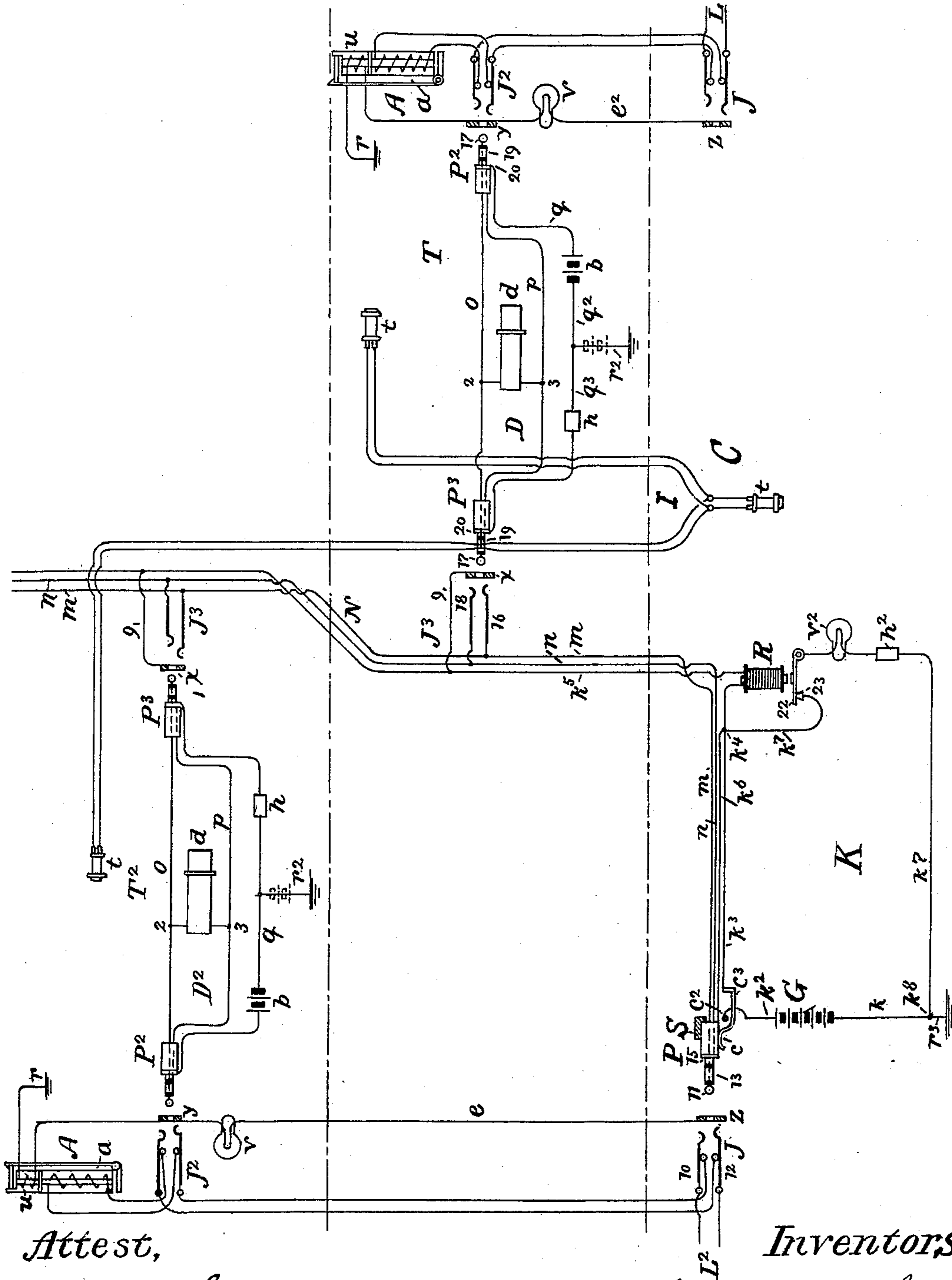
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T. C. WALES, JR. & F. L. RHODES.
SWITCHBOARD APPARATUS, SIGNAL, AND CIRCUIT.

(Application filed Nov. 26, 1897.)

(No Model.)



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SWITCHBOARD APPARATUS, SIGNAL, AND CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 614,677, dated November 22, 1898.

Application filed November 26, 1897. Serial No. 659,868. (No model.)

To all whom it may concern:

Be it known that we, THOMAS C. WALES, Jr., residing at Boston, in the county of Suffolk, and FREDERICK L. RHODES, residing at Winchester, in the county of Middlesex, State of Massachusetts, have invented certain Improvements in Switchboard Apparatus, Signals, and Circuits, of which the following is a specification.

10 This invention concerns the switch apparatus, circuits, and interswitchboard-signals of a telephone-exchange central station, its object being to facilitate and expedite the connections and disconnections of any two
15 lines terminating or having their call-annunciators placed at different switchboards, or, more particularly, the interconnection of two toll-lines provided with call receiving and answering devices at different terminal boards,
20 both, however, passing first through a connecting-board, where they are represented by spring-jack or switch-socket connections.

In the apparatus involving this invention the answering-switch sockets and call-receiving devices of a number of toll-lines may be divided between two or more terminal switchboards, where incoming calls from such lines may be attended to and connections or the initial portion of connections resulting from
25 such calls may be effected; but to provide facilities for effecting switch connections with the said toll-circuits when calls come in for them over other circuits or for much of the outgoing service generally a connection-board is employed on which each toll-line has a
35 spring-jack or switch-socket through which it passes before reaching the terminal board. A local station or interswitchboard trunk-circuit extends from the connecting-board, where
40 it has a switch-plug terminal through the switchboard to the several toll-boards, being provided at each with a suitable switch-socket or jack, so that when it is desired to establish a connection between two toll-lines
45 ending at different terminal boards this can readily be effected by means of the said trunk. The toll or terminal boards are provided with link connections, consisting of a flexible cord conductor with a switch-plug at
50 each end, and a through connection is formed

between any such pair of toll-lines, first, by uniting at the terminal board of the main or toll circuit initiating the call the switch-sockets of the said toll or main telephone-circuit and the local trunk-circuit, respectively, 55 through the plugs and cord conductors of the said link connection, and, second, by inserting the terminal switch-plug of the trunk-circuit in the switch-socket at the connection-board of the main or toll circuit which has
60 been called for.

The usual conductor arranged to serve as a portion of a test, switchboard-signal, and call-signal restoring and locking circuit is associated with each main circuit and unites 65 the contact-pieces or test-rings of the said main-circuit spring-jacks and ends at the terminal board in a ground or return-wire connection, a visible signal, such as a glow-lamp, being included therein at the terminal-board
70 jack. The trunk-circuit has also an associate test-conductor uniting certain switch-contacts or test-rings of its plug-sockets, and the double plug link connections at the terminal boards are in like manner similarly fitted with
75 an associate conductor extending between the test-ring contact-surfaces of the two plugs, connected with the ground or return at its center, and having a test-battery between
80 the plug and ground connection on one side of the latter and a suitable resistance on the other side.

The characteristic feature of the invention is an interswitchboard-signal and busy-test circuit, including a suitable source of current- 85 supply, which circuit we combine with the foregoing instrumentalities. One pole of the said source (which conveniently may be a battery) is grounded or, what is the same thing, united to the return-conductors of the
90 several associate conductors, to which reference has been made. The circuit from the other pole passes by a main conductor to a plug-seat switch, and at a point beyond this divides into a plurality of branch conductors. 95 The trunk-circuit switch-plug terminal when not in use rests in the said plug-seat, which is of course placed at the connecting-board, and when so resting the switch of said plug-seat maintains the normally open condition 100

of the circuit, while the removal of the said plug therefrom allows the said switch to close the circuit. One of the branch conductors of this signal-circuit extends from the dividing-point to a contact-surface on the trunk-plug adapted to register and connect with the socket-contact of the main-circuit associate conductor, so that when the said plug is placed therein this branch will close the circuit by way of the said plug and socket and through the lamp-signal at the terminal board and the call-signal-locking magnet. A second branch conductor extends from the dividing-point through a signal-controlling relay at the trunk-plug station or connecting-board and thence to the associate conductor of the trunk-circuit, so that when at any of the toll or terminal boards the plug of a link-conductor is inserted in a trunk switch-socket this branch conductor has its circuit closed through the associate conductor and resistance of the link connection to the return-conductor attached thereto. Of course both of these branch conductors have branch connections to the test-rings or socket-frames of such socket-switches as their respective principal circuits may be provided with at boards other than that at which a connection is at any time made in order that the potential of the said test-rings may be raised whenever the circuit to which they belong is concerned in a connection elsewhere for the purpose of enabling the customary and well-known busy-test operation to be made. A third branch of the signaling-conductor is altogether localized at the connecting-board and leads from the dividing-point through the circuit-controlling points of the relay of the second branch and then through a supervisory signal, (preferably a lamp,) thence returning to the battery. Thus the continuity of the entire circuit depends on the position of the plug-seat switch, which holds the circuit open when the plug is in its seat, but closes it when the said plug is taken up for use. The continuity of the first branch and the presence of a current therein further depend on the united or separated relations of the trunk-plug and main-circuit switch-socket at the connecting-board.

To close the circuit of the second branch, it is required not only that the trunk-plug at the connecting-board shall be absent from the plug-seat, but also that a link-connection plug shall be in a trunk switch-socket at some one of the toll terminal boards, and when this occurs the relay included therein is excited and attracting its armature opens the third branch circuit at its circuit-controlling points and prevents the display of the signal.

To close the circuit of the third branch conductor, it is necessary, first, that the plug-seat switch shall be closed, and, second, that the circuit of the second branch shall be open, so that the relay-armature shall be retracted.

The registering signal-circuit contacts of

the plug-and-socket switches and the relay-points may thus be regarded as circuit-closers cooperating with the plug-seat switch for their respective branches; but since they also by reverse action open the said branch circuits they more generally may be regarded as circuit-controllers.

The drawing accompanying this specification is a diagram illustrating the combination of circuits and apparatus constituting this invention.

In the drawing, L and L^2 are main telephone-circuits, which may be toll-line circuits.

C is a connecting-operator's position and is termed the "connecting-switchboard" or, briefly, the "connecting-board."

T and T^2 are switchboards where the toll-lines L L^2 terminate. We term them "terminal boards."

N is a local or office trunk-circuit having a terminal switch-plug P at the connecting-board and a spring-jack or switch-socket J^3 at each of the terminal boards.

D and D^2 are switch-cords at the terminal or toll boards, respectively, each with a switch-plug at both ends, and as generally they are arranged to unite the two circuits concerned in a switch connection—in this instance a toll-line and an office trunk—we term them "link connections."

I is an instruction-circuit or call-wire extending between the switchboards and connected at each with the operators' telephones in a manner well understood.

K is the interswitchboard-signal and busy-test circuit, associated mainly with the trunk-circuit N .

On the main circuits L L^2 entering the central station each passes first to a switch-socket J on the connecting-board and thence to its terminal board, where after passing a second switch-socket J^2 it terminates at the main-circuit magnet-coil a of its call-annunciator, (preferably one of the standard self setting and locking type.) At the switch-sockets of the circuits are provided conducting test-rings z and y , which are in fact switch-contacts to register with corresponding contacts on their respective switch-plugs, with the usual associate test and signal-locking conductor and with a visual signal v (ordinarily a lamp) included therein at the terminal board. The said associate conductor passes from the test ring or contact z through the signal v to the terminal-board test-contact y and then through the signal setting and restoring magnet-coil u of the annunciator A to the ground-wire or return-conductor r . The annunciator A is adapted to receive and indicate incoming main-circuit calls, and the lamp v serves as a signal to show the operator at the terminal board when the said main circuit is switched or in use at the connecting-board.

The trunk-circuit N has two main conductors m and n to correspond with the metallic main circuits L L^2 and terminating, respec-

tively, at the connecting-board end in the tip-contact 11 and the forward stem-contact 13 of the trunk-plug P, which contacts are planned to engage and register with the corresponding contacts 10 and 12 of the main-circuit switch-sockets. At the terminal boards the trunk switch-sockets J³ each contain main contacts 16 and 18, branched from and representing the trunk-conductors *m* and *n*. The switch-sockets J³ are also provided with the customary test-rings or auxiliary contacts *x*, and the portion *k*² of the interswitchboard-signal circuit K may be regarded as the usual associate test-conductor, since it electrically unites the said several auxiliary contacts, reaching them by branches 9. The trunk-plug P has a rearward stem-contact 15, which when the said plug is placed in the main-line socket J closes upon the test-ring contact *z* thereof, forming therewith a circuit closer or controller actuated by the insertion and withdrawal of the said plug.

The link-connection cords D D² at the terminal boards have at one end an answering-plug P² and at the other a connection-completing plug P³. The one is adapted to be placed in the main-circuit switch-socket J² to answer an incoming call of the said main circuit, and the other may be placed in the trunk-circuit socket J³ to establish a connection by means of said trunk with a second line at the connection-board. These plugs also have three contacts, the tip-contact 17, the front stem-contact 19, and the rear stem-contact 20, and they engage, respectively, with the main and local circuit contacts of their corresponding main and trunk circuit switch-sockets, the local contacts, as in the connections of the trunk-plug, serving as circuit-controllers for the circuit or branch passing through them, actuated by the insertion of the plugs in their respective sockets and their subsequent withdrawal. The link connections have two main conductors *o* and *p* and an associate conductor *q*. Conductor *o* unites the tip-contacts of the two plugs, conductor *p* unites their front stem-contacts, and conductor *q* unites their rearward stem-contacts. A disconnecting-signal *d*, generally an annunciator, is bridged at 2 and 3 between conductors *o* and *p* to indicate at the terminal board the initial disconnecting-signal. At the center of the associate conductor *q* the ground or return conductor connection *r*² is attached, dividing the said conductor into two sections, one of these, *q*², connecting with the contact 20 of plug P² and including the test-battery *b* and the other, *q*³, connecting with contact 20 of the plug P³ and including in a manner well understood a suitable test resistance *h*. It is evident that when the plugs are inserted into their appropriate switch-sockets the trunk associate conductor *k*⁵ will have its circuit closed through the resistance *h* and return *r*² and that the associate conductor *e*² of the main circuit L will in like

manner have its circuit closed through the test-battery *b* and the return *r*², and that when the plugs are withdrawn these circuits will again be opened.

A plug-seat S is provided at the connecting-board C for the trunk-plug P when not in use, and contained therein is a plug-seat switch *c*, whose members, the contact-stop *c*² and contact-spring *c*³, are normally separated, being forced apart by the body of the plug when the latter is in its seat. At the connecting-board is also a visual signal, such as a lamp *v*², and placed, preferably, near thereto is a relay R.

The interswitchboard-signal and busy-test circuit K has a main conductor, in which is included the source of signaling-current G, which may be a voltaic battery, having one of its poles united by wire *k* to the return-conductor *r*³, which may be either a ground connection or an extension of the return-conductor *r* of the main-circuit and link-connection associate conductors. The other pole of the battery connects by conductor *k*² with one member of the plug-seat switch, whose other member connects by conductor *k*³ with a junction-point *k*⁴, where the circuit divides into a plurality of parallel branches. Thus the main conductor of the circuit extends from the return-wire connection *r*³ to the junction-point *k*⁴, and the plug-seat switch being placed in this part of the circuit it follows that the said switch is adapted to control the entire circuit in all of its ramifications. One branch *k*⁵ leads to the rearward contact of the trunk-plug P, and when the said plug is removed from its seat and inserted in the switch-socket J of a main circuit the circuit of said branch is extended through the contact *z*, the associate conductor *e*, to the lamp-signal *v* and the locking or restoring coil at the terminal board and to the return-conductor *r*. When this branch is closed by the joint operation of the plug-seat switch and the plug-and-socket circuit-controller, a current from the source G flows therein, lights up the lamp-signal *v*, and locks the drop-signal of the annunciator A. A second branch extends from the junction-point *k*⁴ as the associate conductor *k*⁵ of the trunk-circuit and has subbranches 9 to the multiple-socket contacts *x* of the said trunk at the several terminal boards. When the plug P³ of the link connection is placed in such a socket J³, this branch conductor has its circuit closed through the relay R, conductor *k*⁵, subbranch 9, socket-contact *x*, the rearward stem-contact of plug P³, through the section *q*³ of the link-connection associate conductor, including its resistance *h*, to a connection with the return-conductor *r*². Under these conditions the current from the source G circulates in this branch also, exciting the relay R and raising the potential of the several trunk-circuit test-rings *x*, so that at any terminal board the trunk may be tested, if desired, in a well-known

manner to ascertain whether it is engaged or not. Of course the insertion of the answering-plug P^2 in the terminal-board socket J^2 of the main circuit L to answer a call and initiate a through connection in the same way provides a testing potential at the test-ring z of that line and at the same time excites the locking-magnet of the annunciator thereof, resetting and locking the signal. A third branch conductor k^7 is localized at the connecting-board and extends from the junction k^4 through the circuit-controller formed by the points 22 and 23 of the relay R and thence through the lamp-signal v^2 , and preferably through the reducing resistance h^2 to a connection at k^8 with the return-conductor and battery. This branch circuit is closed only when the second branch is open, since the relay-points are brought together when the relay-armature is retracted to its back-limit stop and not when the said armature is attracted. The signal v^2 is thus admirably adapted to serve as a supervisory trunk-signal, since when the said trunk is out of use the circuit is open in the plug-seat switch and the display of the signal thereby prevented, while when the trunk is in use and actively employed the relay remains excited, because the branch containing it is closed, and again the signal v^2 remains unlighted; but when the trunk-circuit having been in use is disconnected at any of its terminal-board sockets the relay-circuit is opened, and the relay closing the third branch displays the signal v^2 and notifies the connecting operator that the trunk-plug may now be withdrawn from the main-circuit socket into which it has been inserted.

The operation of this system is as follows: A call comes in on a main circuit—say the toll-circuit L —for another toll or main circuit terminating at a different terminal branch—say the circuit L^2 . To answer, the answering-plug P^2 of the link connection is placed in the answering-socket J^2 . This cuts off the normal annunciator-coil a , operates the locking-magnet u , restoring and locking the drop-signal, and imparts to the test-ring z of the connecting-board socket a testing potential due to the battery b , so enabling the operator at any time by the usual test to determine whether the line L is free or engaged. Then by means of the instruction-circuit I the toll operator notifies the operator at the connecting-board at which the desired circuit is represented by a switch-socket and announces a call for such circuit. The operator there instructs the toll operator to switch the calling-circuit to a disengaged trunk-circuit, designating which one, and at the same time inserts the plug P of that trunk in the switch-socket of the desired line. These acts unite the calling and desired main circuits, and the disconnecting-signal d is bridged across the circuit at the terminal board. The removal of the plug P from its seat closes the plug-seat switch, thereby imparting a test poten-

tial to the trunk-circuit switch-socket test-rings, the same being regulated by the resistance h in the associate conductor of the link connection, thus affording means whereby the toll or terminal board operators may, if occasion requires, apply the customary busy-test. Current from the signal-circuit source G , leading through the relay R and resistance h to its return, causes the said relay to open the circuit of the connecting-board supervisory signal v^2 . Current from the same battery also passes by way of the trunk-plug P to the terminal-board signal v and locking-magnet of the called line, lighting the lamp-signal to show that such line is engaged, locking the annunciator, and giving the test potential to the test-contacts of this line also. When the conversation is over and the disconnecting-signal d operates, the terminal-board or toll operator, observing the same, takes down the link connection, withdrawing the plugs P^2 and P^3 , and the relay branch circuit being thus opened its armature falls back, operating the circuit-closer of the supervisory-signal branch circuit. As a result current is permitted to flow in the said branch and the lamp-signal v^2 is lighted. This notifies the operator at the connecting-board to disconnect the trunk from the called line and is responded to by withdrawing the plug P from socket J and replacing it in the plug-seat S . The signals v and v^2 are thus both extinguished, current being withdrawn from their respective branch circuits, and the main and trunk circuits are now restored to their normal conditions and are ready for another call.

Of course it is not essential that there shall be but a single connecting-board or that all of the toll-lines shall have their outer switch-sockets on the same connecting-board. Some may be represented on one such board and some on another. We have, however, shown but one to avoid apparent complexity. So, also, it is to be understood that there may be and that in practice there are a number of trunk-circuits extending between the connecting board or boards and the several terminal or toll boards and that at each such terminal board there are several such link-connection cords as we have described. All, however, are operated in the same manner, and we have not considered it essential or important to show more than one.

Instead of connecting the test-battery b in the section q^2 of the associate conductor q of the link connection it may be placed, if desired, in the return connection r^2 , where it will reinforce the current from the source G , care being of course taken that the poles of the two batteries harmonize.

It is evident that if a shunt including the armature of the relay R be placed about the supervisory signal v^2 in the third branch conductor k^7 the opening and closing of the said shunt instead of opening and closing the cir-

cuit itself by the relay would effect the same result as described in a manner well understood.

Having fully described our invention, we claim—

1. In a telephone switchboard apparatus, the combination of a local trunk-circuit having a plug-terminal at a connecting-board and spring-jacks associated with plug and cord-switch connections at other boards; and a main telephone-circuit having a spring-jack at the said connecting-board and a second spring-jack and annunciator at one of the said other boards; with an interswitchboard-signal and busy-test circuit including a source of current, and comprising between the poles of said source a main conductor containing a plug-seat switch controlling the entire circuit, and a plurality of branch conductors, one leading through trunk-plug and main-line spring-jack contacts at the connecting-board, and a visual signal, a spring-jack contact, and the signal-locking winding of the said annunciator at the said other board, another through a signal-controlling relay at the connecting-board to a trunk spring-jack and its associated plug-contacts and cord-switch connections at some one of the other boards and to busy-test contacts at all of the said other boards, and a third through a supervisory signal and the circuit-controlling points of the said relay at the connecting-board; substantially as set forth.

2. The combination in a switchboard apparatus, of two main telephone-circuits each passing through a switch-socket on a connecting-switchboard, to a switch-socket and a self setting and locking call-annunciator on a terminal switchboard, and both provided with the customary associate test and signal-locking conductor, and a visual signal included therein at the terminal board; a station trunk-circuit terminating in a switch-plug at the connecting-board, and having switch-sockets in multiple at the terminal boards respectively, and the customary associate test-conductor branching to switch-contacts in the said sockets; a link connection with a bridged disconnecting-signal at each terminal board, having a switch-plug at each end to connect with the switch-sockets of the main and trunk circuits respectively, and an associate conductor uniting contacts on both plugs which register with similar associate-conductor contacts in the main and trunk circuit switch-sockets; and a signal and test circuit including a battery having one of its poles connected with the said main-circuit and link-connection associate conductors, and comprising a main conductor containing a plug-seat switch at the connection-board controlling the entire circuit, and a plurality of branch conductors, one extending to a contact-piece of the trunk-circuit switch-plug and completed when the said plug is placed in the connecting-board

socket of a main circuit, through the associate conductor of said circuit, a second to a signal-controlling relay and the associate conductor of the trunk-circuit, and completed when the link-connection plug is in a terminal-board trunk-socket through the associate conductor thereof, and a third through the circuit-controlling points of said relay and the supervisory signal controlled thereby, at the connecting-board; substantially as and for the purposes specified.

3. The combination in a telephone switchboard apparatus of two main telephone-circuits both having a switch-socket on a connecting-board, and continuing inwardly to different terminal boards and to a second switch-socket and self restoring and locking annunciator placed thereat; a local or station trunk-circuit extending from a switch-plug at the connecting-board to multiple switch-sockets at the terminal boards, respectively; a plug-seat for said plug when not in use, and a switch therein actuated by said plug; a link connection with a bridged disconnecting-annunciator, at each terminal board, having a switch-plug at each end adapted to connect with the switch-sockets of the main and trunk circuits respectively and an interswitchboard-signal and test-circuit of three branches containing respectively, a busy-signal, a relay, and a supervisory signal, the said branches being controlled collectively by the said plug-seat switch, and severally by independent co-operative circuit-controllers actuated for two of the said branches by the plug-and-socket switch devices at both ends of the trunk-circuit, and for the third by the said relay, substantially as and for the purposes set forth.

4. In a telephone switchboard apparatus, the combination of a local trunk-circuit having a plug-terminal at a connecting-board, and spring-jacks or switch-sockets at other boards; a plug-seat for the reception of said plug while unused, and a switch contained therein actuated by said plug; two main circuits each having an outer switch-socket at a connecting-board, and an inner switch-socket and call-receiving device at separate terminal boards; and switch-cord connections at the said terminal boards, each having a plug at both ends to establish connection between the main and trunk switch-sockets; with an interswitchboard-signal and busy-test circuit, having a main conductor including the said plug-seat switch, and three parallel branch conductors, containing respectively a signal at the terminal board of one of the main circuits, and a circuit-closer therefor actuated by the trunk-circuit switch connections at the connecting-board, a relay at the connecting-board and a circuit-closer therefor actuated by the trunk-circuit switch connections at the terminal board of the other main circuit, and a supervisory signal and circuit-closer therefor actuated by the said relay both at the con-

necting-board, the circuit of each of the said
branches being controlled by the conjoint ac-
tion of their respective circuit-closers and the
plug-seat switch, substantially as herein set
5 forth.

In testimony whereof we have signed our
names to this specification, in the presence of

two subscribing witnesses, this 20th day of
November, 1897.

THOMAS C. WALES, JR.
FREDK. L. RHODES.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.