

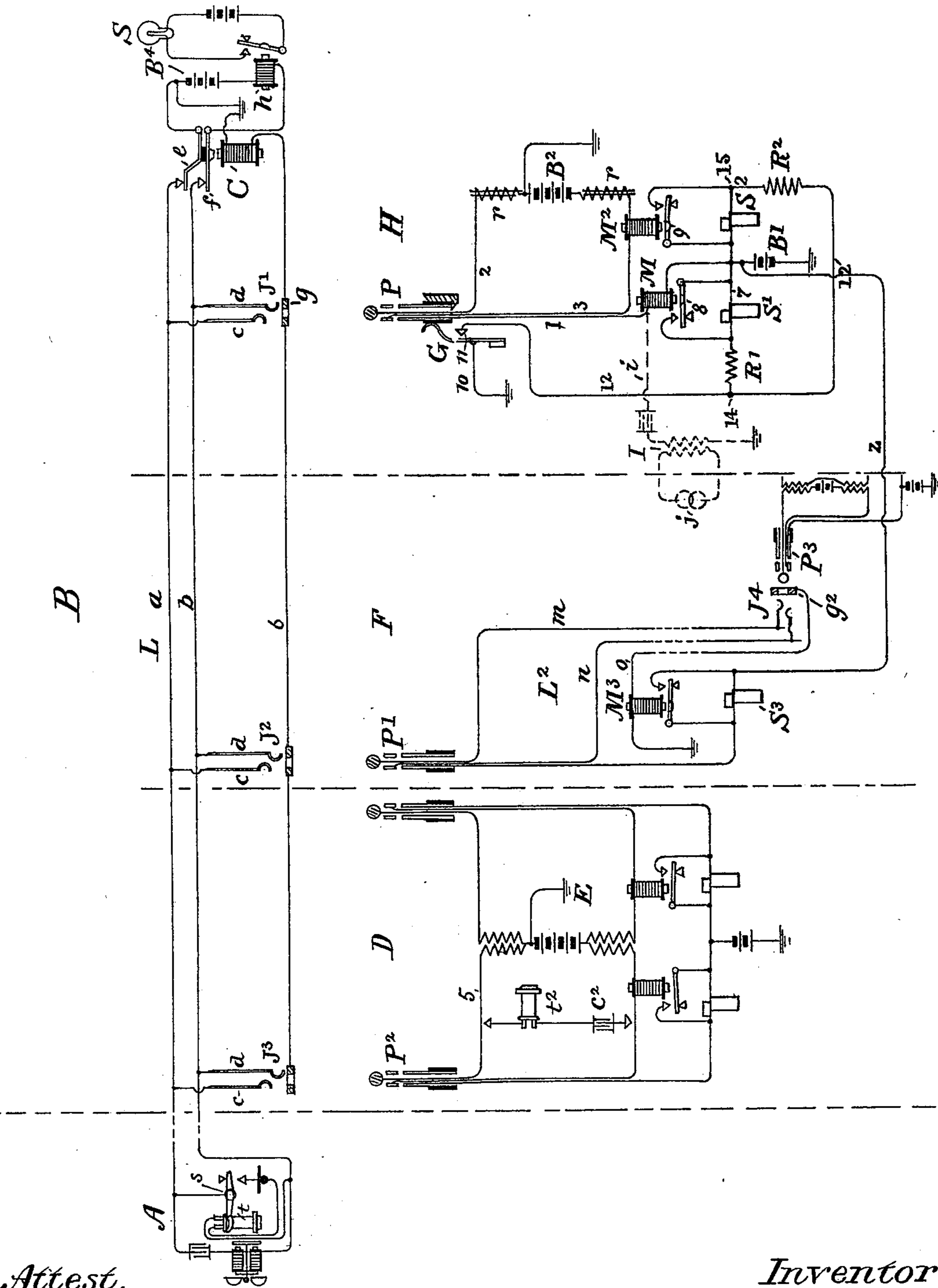
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Patented Feb. 21, 1899.

T. C. WALES, JR.
TELEPHONE SWITCHBOARD CIRCUIT.

(Application filed Oct. 31, 1898.)

(No Model.)



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TELEPHONE-SWITCHBOARD CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 620,004, dated February 21, 1899.

Application filed October 31, 1898. Serial No. 695,031. (No model.)

To all whom it may concern:

Be it known that I, THOMAS C. WALES, Jr., residing at Newton, in the county of Middlesex and State of Massachusetts, have invented certain Improvements in Telephone-Switchboard Circuits, of which the following is a specification.

The present invention relates to the inter-connection of substation telephone-circuits through the intervention of a toll or trunk circuit, and has special reference to the means for guarding the circuits from interference while the preliminary steps are being taken to establish the connection.

The invention mainly concerns common battery or relay circuits wherein when the call is given by a substation for a toll or long-distance connection a considerable interval of time may elapse between the reception of the call by the subscriber's answering operator and the desired connection with the toll-line. With switchboards of the relay type, if during this interval the calling subscriber keeps his telephone off the hook, or, having hung it up, removes it, a false signal will result, as such an act on his part causes the line lamp-signal to be lighted, and any other circuit could be connected with that of the said calling subscriber while he is waiting to be switched to the called-for line, as commonly in making a connection from the line of a calling substation to the toll or trunk the subscriber's operator answers the call in the usual way and finding that the called-for connection is to be made with a toll-line informs the switching operator over an order-circuit of the connection desired and then leaves the said operator to make up the circuit. Thus until she performs this duty the calling-circuit is liable to the interferences mentioned. It becomes very desirable, therefore, to provide means for causing a substation-line to test "busy" during the said waiting and unguarded interval and also to prevent the subscriber from operating his line-signal.

The invention relates to the specific form of relay substation-circuits in which two separate batteries are employed at the central station, one of which, located at the switchboard end of the circuits, serves to cause the illumination of the line lamp-signal when the

telephone is removed from the hook-switch at the substation, the second being located in the switch cord-circuits and adapted to furnish current for the signaling-circuits when two substation-circuits are switched together and for conversational purposes.

In carrying out the invention the relay substation-circuit, provided with normally open terminals at the tables of the several operators, terminates in a cut-off relay and line lamp-signal, as usual, at the answering switchboard-section. The answering operator is provided with the regular cord-circuit by which the call is received, which call is then communicated to the switching-operator over an order-circuit in a manner well understood. To enable the substation-circuit to test "busy" and to prevent the line-signal from being operated, resulting in the display of a false signal, a special cord-circuit is provided, whose plug is inserted in the answering-jack of the line upon the withdrawal of the regular cord-circuit plug and remains there until the switching operator has made the connection with the trunk or toll circuit. This special cord-circuit is provided with two signals, one of which can be controlled from the connected substation and by means of which the original answering operator can be signaled, and the second signal is controlled by the second or switching operator and being operated when she inserts the plug of the toll or trunk circuit into the jack of the calling substation-line constitutes a notice to the said answering operator that the connection has been made and a signal authorizing the withdrawal of the said special cord-circuit from the substation-line. There is a disconnecting-signal in the said toll-line located at the section of the switching operator, and its operation indicates that the conversation is over and that the connection may be taken down.

Referring to the accompanying drawing, which is a diagram illustrative of the invention, L is a substation-circuit consisting of the conductors *a* and *b*, extending from the substation A to the central station B, the same being provided with open terminal spring-jacks or switch-sockets *J*¹ *J*² *J*³ at the several multiple switchboard-sections H, F, and D

and terminating in the armature-contacts *e* and *f* of the cut-off relay C, these being united through the battery B^4 and the relay *h*, while the latter is adapted, by means of its armature and the local circuit controlled thereby, which includes the line lamp-signal S and battery, to display the call-signal when the same is transmitted by action at the substation.

6 is the fixed portion of the busy-test circuit and unites the several test-rings *g* at each switch-socket and has a ground connection through the coils of the cut-off relay C.

The answering-operator is located at H and is provided with a regular cord-circuit to receive all substation-calls in the usual manner, the said cord-circuit not being shown at this section, but being similar to that represented at section D. A special cord-circuit, however, is shown and is provided with one plug P, whose tip-contact is united through the cord-strands with its sleeve-contact, including between the said contacts the relay M^2 and the two helices *r r* of a retardation-coil, between which is the battery B^2 and a branch to ground from one of its poles. The test-ring contact of the plug is connected to ground through the relay M and the battery B' . The plug P rests normally in the seat-switch G, whose spring, which is grounded by the branch 10, is then separated from its contact 11, which connects by the wire 12 with the points 14 and 15, constituting, respectively, the terminals of the conductor 7, in which are included the resistance R' and the signals S' and S^2 . The armatures 8 and 9 of the relays M and M^2 , respectively, are adapted to shunt the signals S' and S^2 , as shown.

The switching operator to whom the call is transferred is located at section F, at which are arranged the terminal plugs P' of the toll or trunk circuits L^2 , whose terminal jacks J^4 may be at a distant central station. The tip of the plug P' is connected with the upper spring of the jack J^4 , while the sleeve is connected with the lower spring, and the test-ring contact of the plug is grounded through signal S^3 and battery B' . The test-ring of the jack J^4 is connected to ground through relay M^3 , whose armature is adapted to shunt the signal S^3 . A sufficient portion of a cord-circuit to illustrate the invention is shown in association with the spring-jack J^4 .

A cord-circuit of the regular type is shown at the switchboard-section D, which represents a second answering-operator's section, to which the substation-circuit is multiplied.

In the operation of the invention it will be assumed that the operator at H has received a call necessitating the use of a trunk-line, that response has been made thereto with the regular cord-circuit similar to that shown at section D, and that the call has been transferred to the switching operator by means of an order-circuit. The answering operator then withdraws the plug of the regular cord-

circuit, lifts the plug P of the special cord-circuit from its seat, (the spring being released makes connection with the contact 11,) and inserts it in the jack J' . Although but one jack is shown, it will be understood that the call having been answered by plugging into the answering-jack the said plug of the regular cord-circuit may remain until the special plug P has been inserted in the regular connecting-jack. Current then flows through the circuit composed of battery B' , relay M, conductor 1, test-ring *g* of jack J' , and cut-off relay C to ground, causing both relays to operate, the former to close a shunt around signal S' and the latter to cut off the battery B^4 and relay *h* from the conductors *a* and *b* of circuit L, and thus extinguish the lamp-signal S. At the same time current flows through the circuit, including battery B' , conductor 7, shunted signal S' , and also through armature 8, resistance R' , and to ground by the wires 12 and 10; but as the signal is short-circuited by the armature it is not displayed. If the telephone *t* at the calling-substation A is off the hook, current will flow via battery B^2 , conductor 2, tip of plug P, spring *c* of jack J' , through the line L, and substation A back to spring *d* of the jack, sleeve of plug, conductor 3, and relay M^2 , causing it to attract its armature and shunt the signal S^2 . Current will then flow from battery B' through armature 9, (as well as through signal S^2), resistance R^2 , and wires 12 and 10 to ground; but the signal S^2 will not operate, being short-circuited by the armature 9; but if the telephone *t* is upon its hook current will flow from battery B' , signal S^2 , which under this condition is not short-circuited, resistance R^2 , and wires 12 and 10 to ground, causing signal S^2 to operate. If for any reason the subscriber wishes to signal the operator at section H, he is thus able by successive movements of the telephone hook-switch *s* to operate the signal S^2 intermittently, since when the telephone is off the hook the signal S^2 is not displayed, while when it is hung upon the hook the said signal is displayed. So long as the plug P of the special cord-circuit remains in the jack J' the line L is held "busy," as will now be illustrated by reference to section D of the switchboard, which represents the section of another answering operator, to which the circuit L is multiplied. This operator, wishing to ascertain whether the line is busy or free, touches the tip of the plug P^2 to the ring of the jack or socket J^3 . Current will flow from battery B' through relay M, conductor 1, test-ring *g* of jack J' , conductor 6, test-ring of jack J^3 , tip of plug P^2 , conductor 5, and ground E. This flow of current causes a momentary charge or surge of current through the operator's telephone *t^2*, causing the "click" which constitutes the sound-signal of the busy test, indicating the line tested to be in use. When the switching operator at F proceeds to complete the connection with the toll-circuit, she inserts the plug P' of the

circuit into jack J^2 , and as the operator has meanwhile called for the circuit wanted at the other end of the toll-line L^2 and the plug P^3 of the cord-circuit there has been inserted in the jack J^4 of the toll-line, and thereby introduced current from the cord-circuit grounded battery to the signal-wire o of the toll-line, the armature of the relay M^3 is attracted. Current now flows from battery B' through conductor z to armature of relay M^3 and signal S^3 , test-ring contact of plug P' , ring of jack J^2 , conductor 6, and cut-off relay C to ground, and the resistance of this circuit is so low that the relay M at section H is short-circuited, it now being in parallel with the shunted signal S^3 , and the armature 8 falls away. Current then flows from battery B' through wire 7, signal S' , resistance R' , wires 12 and 10 to ground, thereby operating signal S' , whereupon the answering operator withdraws plug P from jack J' and replaces it in the plug-seat switch G , opening the circuit through the signal S' , which returns to its normal position.

At section H there is indicated in dotted lines means for holding the substation-line busy by a tone test in connection with the usual test. It consists of a condenser in series with the secondary winding of an induction-coil I in a conductor i , leading from the conductor 1 to ground, the primary of the said induction-coil being in closed circuit with a source j of rapidly-alternating current. The induced current in the secondary circuit is in this case placed on the line in an exactly similar manner to the click test described herein, and being received by the operator in the same way as the regular busy test it in no wise changes the operation of the circuit.

I claim—

1. The combination with a main telephone-circuit; switch-sockets or spring-jacks therefor at the several sections of a multiple switchboard; and a fixed portion of a test-circuit uniting the test-rings of said sockets; of a source of test-current, a special switch-plug, and a test-conductor uniting the said source to a test-ring engaging contact of the said plug, all at one of the said sections; a local signal-circuit; a plug-seat switch operated by the said special plug controlling the same; a supervisory signal in said local circuit; and a shunt therefor, all at the same section; a relay in circuit with the test-conductor of said special plug controlling the said signal-shunt; and switch-plug devices at another switchboard-section organized to establish a union between the said main circuit and any other, to establish the busy test there, and to simultaneously short-circuit the said relay, and thereby operate the supervisory signal of the first section.

2. The combination with a telephone-line and multiple spring-jacks thereof in different sections of a switchboard, and a test-circuit for the said spring-jacks; of a source of test-current, and means for connecting the same

with the test-circuit of the line at one of said sections consisting of a switch-plug carrying a contact forming the terminal of said source; an electromagnetic signal at the same section; and means for associating it with the line coincident with the connection of the test-current, said means consisting of a grounding plug-seat switch, and a relay in series with the said plug-contact terminal; means for shunting the said signal consisting of the said relay and its armature; means for closing the test-circuit at a second section of the switchboard to obtain a test-signal; and other means at the said section made operative in establishing connection with the line, to display said supervisory signal, as set forth.

3. The combination with a substation telephone relay-controlled main circuit; multiple spring-jacks thereof in different sections of the switchboard; and a normally open test-conductor uniting the test-rings of the spring-jacks; of a source of test-current; a plug having a contact-terminal, adapted to make connection with the said test-rings in series with a relay, and with said source of current, the relay when the plug is so connected being in series with the cut-off relay of the said line; a supervisory signal; and a conductor including the signal, connected between the said relay and source of current; the said signal being short-circuited when the plug is in a spring-jack; with means at a second section for testing the line to determine the presence of the test-current; a plug for making connection with the line at the said second section and when connected to shunt the said relay; and a source of current in circuit with said plug adapted to be brought into circuit with the supervisory signal in making said connection; as set forth.

4. The combination with a substation main telephone-circuit; multiple spring-jacks thereof in different sections of a central-station switchboard; and a test-circuit for the said spring-jacks; of a special supervisory signal at one of said sections; means at such section for associating it with the substation-circuit and for vitalizing it; means at the substation for operating the same; a source of test-current; means for connecting the same with the test-circuit of the line; a second supervising-signal at the said section; and means for associating it with the line, coincident with the connection of the test-current; means for closing the test-circuit at a second section of the switchboard to obtain a test-signal; and other means at the said section made operative in establishing connection with the line, to display said second supervisory signal, as set forth.

5. The combination with a substation main telephone-circuit; multiple spring-jacks therefor in different sections of the central-station switchboard; and a test-circuit for the spring-jacks; of a special supervisory signal at one of said sections, and means at such section for associating it with the substation-cir-

cuit and for vitalizing it; means at the sub-
station for operating the same; a source of
special test-current; a switch-plug for con-
necting the same, with the test-circuit of the
5 line at the said section; an electromagnetic sig-
nal at the said section; means for associating
it with the line coincident with the connection
of the test-current, said means consisting of
a circuit-closing plug-seat switch, and a relay
10 in series with the said plug-terminal; means
for shunting the said signal consisting of the
said relay and its armature; means for clos-
ing the test-circuit at a second section of the
switchboard to obtain a test-signal and other
15 means at the said second section made oper-
ative in establishing connection with the line,
to display said supervisory signal, as set forth.

6. In combination with substation main
telephone-circuits; a special cord-circuit pro-
20 vided with one plug only, normally resting

in a grounding plug-seat switch, the line-con-
ductor terminals of said plug being in series
with each other and with a retardation-coil,
a battery, and a relay, and the test-conduc-
tor terminal of the plug being in series with 25
a second relay and a battery, the said battery
having two normally open independent
branches to the plug-seat switch, each hav-
ing in series a supervisory signal and a re-
sistance-coil, the respective armatures of the 30
said relays being each adapted to short-cir-
cuit one of the said signals, as set forth.

In testimony whereof I have signed my
name to this specification, in the presence of
two subscribing witnesses, this 18th day of 35
October, 1898.

THOMAS C. WALES, JR.

Witnesses:

GEO. WILLIS PIERCE,
JOSEPH A. GATELY.