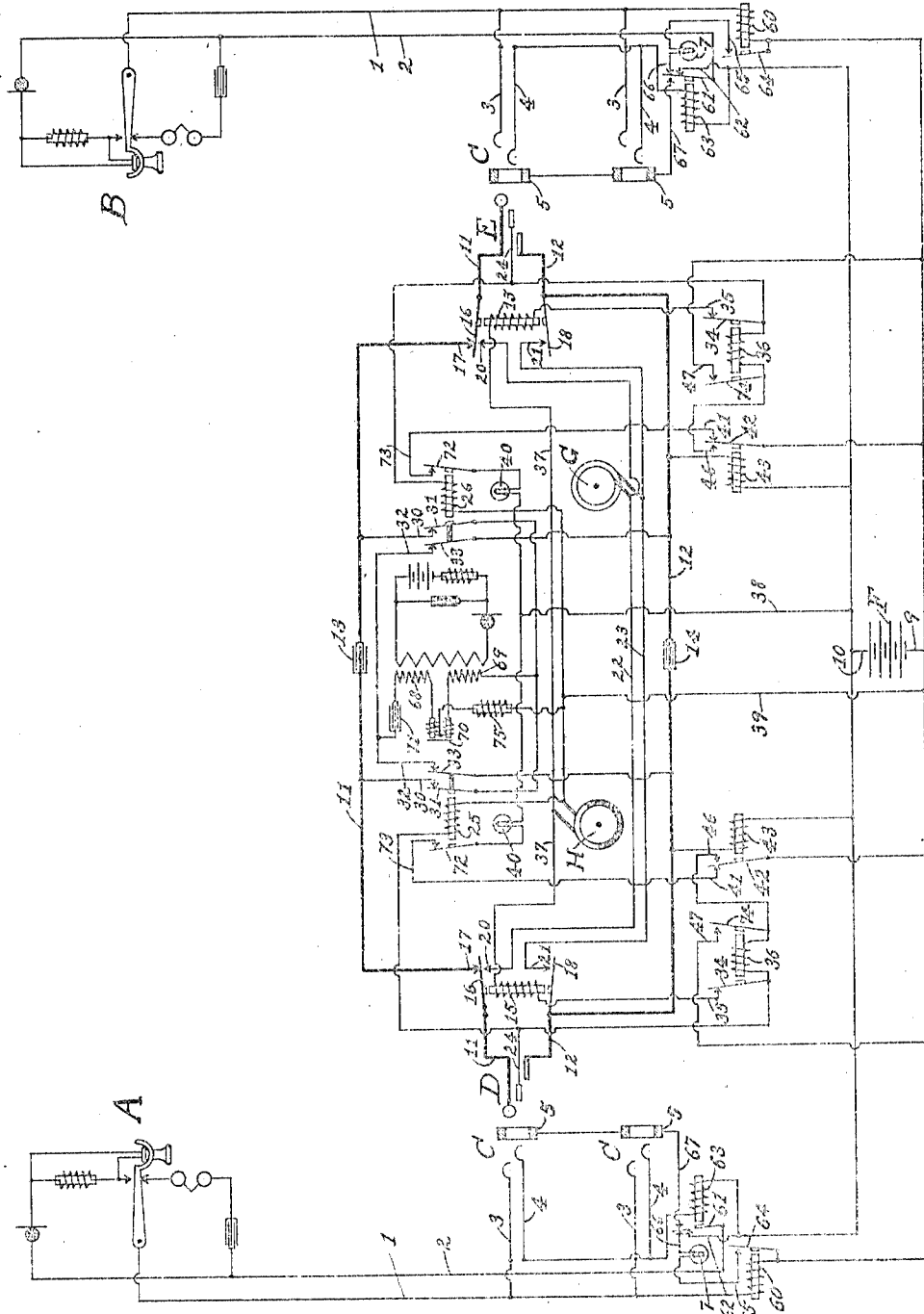


E. R. CORWIN.
 BUSY TEST FOR TELEPHONE SYSTEMS.

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1,040,631.

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WITNESSES:

Frank J. Ryan
Wm. Thompson

INVENTOR:

Elmer R. Corwin
 BY *Frederick P. Parker*
 ATTORNEY.

UNITED STATES PATENT OFFICE.

ELMER R. CORWIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO CORWIN TELEPHONE MANUFACTURING COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

BUSY-TEST FOR TELEPHONE SYSTEMS.

1,040,631.

Specification of Letters Patent.

Patented Oct. 8, 1912.

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To all whom it may concern:

Be it known that I, ELMER R. CORWIN, a citizen of the United States of America, residing at Chicago, in Cook county, Illinois, have invented a new and useful Busy-Test for Telephone Systems, of which the following is a specification, reference being had to the accompanying drawing, illustrating same.

My invention relates to telephone systems and deals principally with the busy-test for such systems.

The principal objects of my invention are to provide an improved busy-test arrangement for multiple telephone systems; and to provide improved means or automatically controlling the busy-test arrangement in such systems.

Other objects will be apparent from the following specification.

In the telephone system illustrated in the accompanying drawing I supply a ringing relay and an operator's disconnecting relay, both associated with a plug of the plug-cord connecting circuit, with current from a line connection extending through a third conductor of the cord, plug and any one of a plurality of line jacks, for operating the said relays when connection is made with the line. Then I provide a locking relay in the plug-cord circuit and supply this relay with current through the said line connection when the subscriber removes his receiver from the switch-hook while connection is made with the line, to cause the latter said relay to lock the ringing relay in a non-ringing position until the connecting plug is removed from the line jack. The operator's disconnecting relay in addition to controlling the operator's circuit also helps control a supervisory signal. I also provide a supervisory relay associated with the said plug of the plug-cord circuit, for partially controlling the supervisory signal, and a line relay, through both of which relays the subscriber's line is supplied with current for talking purposes during conversation. The supervisory relay in addition to controlling the supervisory signal also places the locking relay in locked position when the subscriber removes his receiver from the switch-hook while connection is made with the line.

I preferably provide each of the pair of plugs in a plug-cord connecting circuit with

all of the relays above mentioned, to provide automatic ringing for each of the plugs and to properly control the operator's circuit and supervisory signals as will be hereinafter described, but I wish it to be understood that I may do away with the ringing relay and the locking relay associated with one of the plugs, if it is desired to ring out over only one plug of the pair.

In the operator's telephone set I provide an impedance coil connected from one pole of a central source of electricity to a medial point of the operator's telephone receiver winding, the latter being normally connected with the tip strands of the connecting plugs, so as to provide a path for the busy-test currents which extends through the said impedance coil, a portion of the operator's receiver winding and a tip strand of either cord and plug of a pair. The busy-test is facilitated by the change of potential of the line-jack test terminals, which indicates the condition of the line, in the operator's receiver, when the tip of a connecting plug is connected with a line-jack test terminal of the line. The operator's disconnecting relays control the busy-test circuit over the respective connecting cords and plugs of a pair.

I will now describe my invention more in detail, by reference to the accompanying drawing which illustrates two subscribers' telephone lines and the plug-cord connecting circuit therefor, the whole being adapted, and provided with apparatus, to carry out my present invention. The particular line circuit and connecting circuit herein illustrated forms the subject matter of my copending application for Letters Patent on telephone system filed herewith.

In the drawings the lines A and B are each provided with a substation at which the circuit of the line is closed when the receiver is removed from the switch-hook, in the usual manner, the circuit of the line being open when the receiver is hung upon the switch-hook. Limb 1 of each line extends to terminals 3 3 of line spring-jacks C C, in multiple, and also through a line relay 60 to pole 9 of a central battery F. Limb 2 of each line extends through a normally closed contact 61--62 of a cut-off relay 63 to pole 10 of battery F. Relay 63 is connected from pole 10 of battery F to terminals 4 4 of the jacks C C, in multiple.

When relay 60 is energized it closes contact 64—65 in the circuit of a line lamp 7. When relay 63 is energized it opens contacts 61—62 and 61—66, and closes contact 61—67, contact 61—66 being in the circuit of line lamp 7 and contact 61—67 being in circuit with the terminals 5 5 of the jacks C C, which terminals 5 5 are in multiple.

In the plug-cord connecting circuit the talking strands 11 and 12 of each plug D and E are connected together through condensers 13 and 14, respectively. Each plug D and E has a ringing relay 15 associated therewith to control suitable contacts. When either of the relays 15 15 is energized, spring members 16 and 18 thereof are caused to engage contacts 20 and 21, respectively, which are connected through conductors 22 and 23, respectively, to a ringing generator G, spring member 16 also disengaging contact 17. Each of the plugs D and E is provided with a third strand or conductor 24 adapted to furnish a connection through any one of the several jack-springs 4 4 when the plug is connected with a line jack, to furnish current supply for operating the several relays in the plug-cord circuit. A pair of operator's disconnect relays 25 and 26 are connected from the respective strands 24 24 of the plugs D and E, to pole 9 of battery F, such connections causing these relays to become energized when their respective plugs are connected with line jacks. The secondary 68 69 of an operator's induction coil, an operator's receiver 70, and a condenser 71, are bridged from talking strand 11, on opposite sides of condenser 13, to talking strand 12, on opposite sides of condenser 14, preferably as shown, through normally-closed contacts 30—31 and 32—33 of each of the relays 25 and 26, in multiple, so that the operator's set will be entirely disconnected from the talking strands 11 and 12 of the cord circuit when both of the relays 25 and 26 are energized. An impedance coil 75 is connected from between the magnet coils of the receiver 70, through conductor 39 to pole 9 of battery F. This coil 75 is to enable a busy-test to be made as hereinafter described.

The arrangement of the operator's relays 25 and 26, is practically the same as in my copending application for Letters Patent on telephone system, Serial No. 414,078, but in addition to controlling the operator's circuit these relays are in this present application also arranged to control the supervisory signals as will be hereinafter described. When either of the relays 25 or 26 is energized it closes a contact 72—73 in the corresponding supervisory signal circuit. To each strand 24 of the plugs D and E is connected the corresponding ringing relay 15, through a normally-closed contact 34—35 of

a locking relay 36, the circuit from each ringing relay 15 extending through conductor 37, rotary intermittent circuit-closer H, and conductor 39, to pole 9 of battery F. Each supervisory lamp 40 is connected through conductor 38 to pole 10 of battery F. From talking strand 12, on opposite sides of conductor 14, are connected a pair of supervisory relays 43 43, to pole 10 of battery F. When either of the supervisory relays 43 43 is energized it causes spring member 42 thereof to disengage contact 41 and to engage contact 46 which leads to the winding of the corresponding locking relay 36. Thus in addition to controlling the supervisory signals, the relays 43 43 are also arranged to control the circuits of the respective locking relays 36 36. When either of the locking relays 36 36 is energized it causes spring member 34 thereof to disengage contact 35, and spring member 74 to engage contact 47, spring member 34 being connected to the corresponding strand 24 and contact 47 being connected to pole 9 of battery F.

The operation of the system is as follows: When a party at substation A desires to make a call, he lifts his telephone receiver from the switch-hook in the usual manner, which closes the circuit between limbs 1 and 2 of his line and thereby closes a circuit from pole 9 of battery F, through his line relay 60, line A, and contact 61—62, to pole 10 of battery F. Current from battery F flowing through this circuit energizes line relay 60 and thereby causes same to close contact 64—65 which bridges the line lamp 7 through contacts 66—61—62 across battery F. Current from battery F now flowing through line lamp 7 lights this lamp which signals the operator at the central station for a connection, whereupon the operator inserts one of the plugs D or E into a jack C of line A to answer the call. The plug contacts 11, 12 and 24 now engage jack terminals 3, 5, and 4, respectively, thereby closing a number of circuits through battery F, which circuits will now be traced and explained as follows:

First. From pole 9 of battery F, through conductor 39, one of the operator's disconnect relays 25 or 26 (say 25), strand 24 of the connected plug (say D), a jack-spring 4, and cut-off relay 63, to pole 10 of battery F. Current from battery F flowing through this circuit energizes relay 25 and thereby causes its armature to be attracted and to open contacts 30—31 and 32—33 and close contact 72—73. Although contacts 30—31 and 32—33 of relay 25 are now open, which disconnects the operator's telephone set and the busy-test arrangement from plug D, the operator's telephone set is still bridged across the plug-cord talking circuit from talking strand 11, through contacts 130

30—31 and 32—33 of relay 26, to talking strand 12. Contact 72—73 being closed does not cause the supervisory lamp 40 associated therewith to light, because contact 41—42 is simultaneously opened as will be hereinbelow described. The current now flowing in circuit 39, 25, 24, 4, 63, also energizes the cut-off relay 63 and thereby causes its armature to be attracted and to open contacts 61—62 and 61—66 and close contact 61—67. Contact 61—66 being open extinguishes line lamp 7. Contact 61—62 being open disconnects pole 10 of battery F from limb 2 of line A. Contact 61—67 being closed connects limb 2 of line A to the several line-jack terminals 5 5.

Second. From pole 10 of battery F through supervisory relay 43 on the connected-plug side of the cord-circuit, strand 12, a jack terminal 5, contact 67—61, line A, and line relay 60, to pole 9 of battery F. Current from battery F flowing through this circuit energizes relay 43 and thereby causes its armature to be attracted and to open contact 41—42 and close contact 42—46. Contact 41—42 now being open prevents the supervisory lamp 40 associated therewith from displaying a signal. Contact 42—46 being closed closes a circuit from pole 9 of battery F, through contact 42—46, locking relay 36, strand 24 of the connected plug, a jack terminal 4, and cut-off relay 63, to pole 10 of battery F. Current from battery F flowing through this latter circuit energizes relay 36 and thereby causes its armatures to be attracted and to open contact 34—35 and close contact 74—47, respectively. Contact 34—35 now being open prevents ringing relay 15 from becoming energized. Contact 74—47 being closed closes a circuit from pole 9 of battery F, through contact 47—74, relay 36, strand 24, jack terminal 4, and cut-off relay 63, to pole 10 of battery F. Current from battery F flowing through this latter circuit will keep relay 36 energized and its armatures attracted, even if contact 42—46 is opened, contacts 47—74 and 42—46 being in multiple in the circuit of relay 36. Thus the armatures of relay 36 are locked in attracted position until the connecting plug is removed from the line jack C. The operator now receives from the party at substation A, instructions to connect his line for conversation with substation B, whereupon the operator takes the idle connecting plug of the pair and tests line B to ascertain whether it is busy or not, as will now be described. In making the busy-test on line B the operator merely touches the tip contact of the idle connecting plug E against a terminal 5 of a jack C of line B, in the usual manner. If line B is idle the jack terminals 5 5 will all be disconnected from the battery F at contact 67—61 which is then open, so that the testing plug will be unable to close any

complete circuit, by its tip being touched against one of the jack terminals 5 5, to give a signal to the operator. If line B is busy, the jack terminals 5 5 thereof will be connected to pole 10 of battery F, through a circuit similar to the circuit including a supervisory relay 43 and strand 12, established by some other connecting plug in the system. Under this latter condition the operator in making the busy-test closes a circuit from a jack terminal 5 of line B, which is connected to pole 10 of battery F as above described, through tip strand 11 of the testing plug E, contact 30—31 of relay 26, a portion 69 of the secondary of the operator's induction coil, a portion of the winding of the operator's receiver 70, impedance coil 75, and conductor 39, to pole 9 of battery F. When the operator touches the tip of the testing plug against the ring or sleeve 5 of a jack of line B, if line B is busy, an impulse of current from battery F flows through the last-described circuit and thereby produces a "click" in the operator's receiver 70 which indicates to her that line B is busy, or in use. The loudness of the operator's busy click can be regulated by regulating the resistance of the coil 75. It will be readily understood that plug E may be the answering plug and plug D the calling plug, if desired, in which case the busy-test will be made with plug D in a manner similar to that just described in connection with plug E. Assuming that the line B is not in use, the operator inserts the idle connecting plug of the pair into a line jack C of line B, thereby closing a number of circuits through battery F which circuits will now be traced and explained as follows:

First. From pole 9 of battery F through conductor 39, the operator's disconnect relay 26, strand 24 of the calling plug, a jack-spring 4 of line B, and cut-off relay 63, to pole 10 of battery F. Current from battery F flowing through this circuit energizes relay 26 and thereby causes its armatures to be attracted and to open contacts 30—31 and 32—33, and close contact 72—73. Now the operator's telephone set and the busy-test arrangement are entirely cut off from the talking strands 11 and 12 of the plug-cord circuit, at contacts 30—31 and 32—33 of relays 25 and 26. Contact 72—73 being closed closes a circuit from pole 10 of battery F, through conductor 38, supervisory lamp 40 which is associated with relay 26, contact 72—73 of relay 26, and contact 41—42 of supervisory relay 43 which is associated with the calling plug, to pole 9 of battery F. Current from battery F flowing through this circuit lights the supervisory lamp 40 which shows to the operator that the circuit of line B is open. The current now flowing in circuit 39, 26, 24, 4, 63, also energizes the cut-off relay 63 of line B and

thereby causes its armature to be attracted and to open contacts 61—62 and 61—66 and close contact 61—67. Contact 61—66 being open prevents line lamp 7 from displaying a signal when the circuit of the line is closed. Contact 61—62 being open disconnects pole 10 of battery F from limb 2 of line B. Contact 61—67 being closed connects limb 2 of line B to the several line-jack terminals 5 5.

Second. From pole 9 of battery F through conductor 39, intermittent circuit-closer H, conductor 37, ringing relay 15 associated with the calling plug, contact 35—34 of locking relay 36, strand 24 of the calling plug, a jack-spring 4 of line B, and cut-off relay 63, to pole 10 of battery F. Current from battery F flowing through this circuit, when the circuit-closer H closes the circuit, energizes ringing relay 15 and thereby causes its armatures to be attracted and to close contacts 16—20 and 18—21, respectively, armature 16 also opening contact 16—17. While the ringing relay 15 is energized, a circuit is closed from ringing generator G, through conductor 22, contact 20—16 of ringing relay 15 which is associated with the calling plug, strand 11, jack-spring 3, limb 1 of line B, the ringer and condenser at substation B, limb 2 of line B, contact 61—67 of relay 63, jack-terminal 5, strand 12 of the calling plug, contact 18—21 of ringing relay 15, and conductor 23, back to the generator G. Current flowing from the generator G through this circuit rings the ringer at substation B and thereby signals the party at this telephone. The ringer at substation B is rung intermittently, due to the fact that the ringing generator circuit over line B is closed intermittently by ringing relay 15 which is energized intermittently from battery F through the intermittent circuit-closer H.

When the party at substation B answers his call and lifts his receiver from the switch-hook, he closes the circuit between limbs 1 and 2 of his line and thereby closes a circuit from pole 10 of battery F, through supervisory relay 43 which is associated with the calling plug, strand 12, jack-terminal 5 of line B, contact 67—61 of relay 63, line B, and line relay 60, to pole 9 of battery F. Current from battery F flowing through this circuit energizes relay 43 and thereby causes its armature to be attracted and to open contact 41—42 and close contact 42—46. Contact 41—42 being open extinguishes lamp 40 which indicates to the operator that the party at substation B has answered his call. Contact 42—46 being closed closes a circuit from pole 9 of battery F, through contact 42—46, locking relay 36, strand 24 of the calling plug, jack-spring 4 and relay 63, to pole 10 of battery F. Current from battery F flowing through

this circuit energizes relay 36 and thereby causes its armatures to be attracted and to open contact 34—35 and close contact 74—47, respectively. Contact 34—35 being open renders ringing relay 15 incapable of further operation and thereby stops the ringing over line B. Contact 74—47 being closed closes a circuit from pole 9 of battery F, through contact 47—74, locking relay 36, strand 24 of the calling plug, jack-spring 4 of line B, and relay 63, to pole 10 of battery F. Current from battery F flowing through this latter circuit will keep relay 36 energized and its armatures attracted, even if contact 42—46 is opened, contacts 47—74 and 42—46 being in multiple in the circuit of relay 36. Thus the armatures of relay 36 are locked in attracted position until the connecting plug associated therewith is removed from the line jack C. Now the parties at substations A and B are connected for conversation with each other, over limbs 1 and 2 of their lines and talking strands 11 and 12 of the plug-cord circuit. When the conversation is completed, the party at substation A hangs his receiver upon the switch-hook, which breaks the circuit of his line in a manner well understood and thereby stops the flow of current through the supervisory relay 43 which is associated with line A. This supervisory relay 43 is now deenergized whereupon the armature thereof releases and closes the back contact 42—41 which closes a circuit from pole 9 of battery F, through contact 42—41, contact 73—72, supervisory lamp 40 which is associated with line A, and conductor 38, to pole 10 of battery F. Current flowing from battery F through this latter circuit causes the supervisory lamp 40 to light and thereby convey to the operator the signal for disconnection of line A.

The party at substation B by hanging his receiver upon the switch-hook, controls circuits and gives his disconnect signal to the operator the same as just described in connection with line A. Now the operator, having received both disconnect signals from substations A and B, withdraws the connecting plugs D and E from the line jacks and thereby opens the circuits of the locking relays 36 36 and the operator's disconnect relays 25 26, over the line connections, thus deenergizing all of the relays 36, 36, 25 and 26 and causing the armatures thereof to release. Relays 36 36 now close contacts 34—35 34—35 in the respective circuits of ringing relays 15 15, but these latter relays are not energized by such contacts being closed because the circuits of the relays 15 15 over the line connections are now open at the connecting plugs. Relays 25 and 26 now open the contacts 72—73 72—73 in the respective supervisory lamp circuits and thereby extinguish the said lamps 40 40.

Now all of the circuits and apparatus are restored to normal position and condition preparatory for another cycle of operations as just described.

It will be seen that the locking relays 36 keep the ringing relays 15 15 from ringing back on the lines after the parties at the substations A and B have hung their receivers upon the switch-hooks and the supervisory relays 43 43 have been deenergized and opened contacts 42—46 42—46 in the first closed paths through the locking relays 36 36, while connection is still made with the lines, due to contacts 47—74 47—74 being closed.

Attention is called to my two co-pending applications Serial No. 625,088, filed May 4, 1911 and Serial No. 644,042, filed August 14, 1911.

I do not wish to limit this invention to all of the particular details of construction, or to the particular types of apparatus, herein shown, as many modifications may be made therein without departing from the scope of the appended claims.

What I claim as my invention is:

1. In a telephone system having lines, a plug-cord connecting circuit for the lines, an operator's telephone set including a receiver, normally connected with the plug-cord circuit, a relay associated with each of the connecting plugs of a pair for disconnecting the operator's telephone set from the respective connecting plugs when the latter are connected with respective lines, and an impedance coil connected from the operator's telephone receiver to a source of electricity, whereby a busy-test circuit is normally established from a conductor of either said connecting plug through contacts of the respective said relays, the operator's telephone receiver, and the said impedance coil, for purposes substantially as described.

2. A telephone system having lines, a plug-cord connecting circuit for the lines, a source of electricity, a plurality of connection terminals for each of the lines, each connection terminal having a test contact, the test contacts for each of the lines being connected together and normally disconnected from the said source of electricity, an operator's telephone set normally connected with the plug-cord connecting circuit, a relay for disconnecting the operator's telephone set from a connecting plug when the latter is connected with a line, and an impedance coil connected from the operator's telephone receiver to the said source of electricity, whereby a test circuit is normally established from a conductor of a connecting cord and plug through a contact of the said relay, the operator's telephone receiver, and the said impedance coil, the said test circuit cooperating with the line test contacts for purposes substantially as described, and means for changing

the potential of the said line test contacts when connection is made with the line.

3. A telephone system having lines, a plug-cord connecting circuit for the lines, a source of electricity, a plurality of connection terminals for each of the lines, each connection terminal having a test contact, the test contacts for each of the lines being connected together and normally disconnected from the said source of electricity, an operator's telephone set including a receiver, normally connected with the connecting plugs of the plug-cord connecting circuit, a pair of relays associated with the respective connecting plugs of a pair, said relays being adapted to disconnect the operator's telephone set from the respective connecting plugs when the latter are connected with respective lines, and an impedance coil connected from the operator's telephone receiver to the source of electricity, whereby a test circuit is normally established from a conductor of either connecting cord and plug of the pair through contacts of the respective said relays, the operator's telephone receiver, and the said impedance coil, said test circuit cooperating with the test contacts of the lines for purposes substantially as described, and means for connecting the said test contacts of the lines with the said source of electricity when connection is made with the lines.

4. In a telephone system having lines, a plug-cord connecting circuit for the lines, an operator's telephone set normally connected with a connecting plug of the connecting circuit, a ringing relay associated with the said connecting plug and arranged to automatically send a ringing current over a line when connection is made therewith, an operator's disconnect relay associated with the said connecting plug and adapted to disconnect the operator's telephone set from the said plug when connection is made with a line, and an impedance coil connected from the operator's telephone receiver to a source of electricity, whereby a test circuit is normally established from a conductor of the said connecting plug through a contact of the ringing relay, a contact of the operator's disconnect relay, the operator's telephone receiver, and the said impedance coil, to cooperate with the lines for purposes substantially as described.

5. In a telephone system having lines, a plug-cord connecting circuit for the lines, the said connecting circuit terminating in a pair of connecting plugs, an operator's telephone set normally connected with the connecting circuit, a ringing relay associated with each of the said connecting plugs for automatically sending a ringing current over a line when connection is made between either of the said connecting plugs and a line, a pair of operator's disconnect relays

associated with the said connecting plugs and adapted to disconnect the operator's telephone set from the plug-cord connecting circuit when the said plugs are connected with respective lines, and an impedance coil connected from the operator's telephone receiver to a source of electricity, whereby a test circuit is normally established from a conductor of either connecting plug of a pair through contacts of the respective ringing relays, contacts of the respective operator's disconnect relays, the operator's telephone receiver, and the said impedance coil, the said test circuit cooperating with the lines for purposes substantially as described.

6. A telephone system having lines, a plurality of connection terminals for each of the lines, a source of electricity, each of the said connection terminals having a test contact, the test contacts for each of the lines being connected together and normally disconnected from the said source of electricity, a plug-cord connecting circuit for the lines, an operator's telephone set normally connected with the plug-cord connecting circuit, a supervisory signal associated with each of the plugs of a pair, a pair of supervisory relays associated with each of the said supervisory signals for controlling the latter, one of the said supervisory relays of each pair being adapted to disconnect the operator's telephone set from the corresponding connecting plugs when connection is made between the latter and respective lines, the other said supervisory relay of each pair furnishing paths for connecting the test contacts of respective lines with the said source of electricity when connection is made between the corresponding connecting plugs and the lines, and an impedance coil connected from the operator's telephone receiver to the source of electricity, whereby a test circuit is established from a conductor of each of the connecting plugs of a pair through contacts of the respective supervisory relays which control the operator's telephone set, the operator's telephone receiver, and the said impedance coil, the said test circuit cooperating with the said line test contacts for purposes substantially as described.

7. In a telephone system having lines, a plurality of connection terminals for each of the lines, a source of electricity, each of the said connection terminals having a test contact, the test contacts for each of the lines being connected together and normally disconnected from the said source of electricity, a relay associated with each of the lines for connecting the said test contacts thereof with a limb of the line when connection is made with the line, a plug-cord connecting circuit for the lines, an operator's telephone set normally connected with the plug-cord connecting circuit, a supervisory signal associated

with a connecting plug of the plug-cord circuit, a pair of supervisory relays for controlling the said supervisory signal, one of the said supervisory relays being adapted to disconnect the operator's telephone set from the corresponding connecting plug when connection is made between the latter and a line, the other said supervisory relay furnishing a path for connecting the test contacts of a line with the said source of electricity when the said connecting plug is connected with a line, and an impedance coil connected from the operator's telephone receiver to the said source of electricity, whereby a test circuit is established from a conductor of the said connecting plug through a contact of the said supervisory relay which controls the operator's telephone set, the operator's telephone receiver, and the said impedance coil, the said test circuit cooperating with the said line test contacts for purposes substantially as described.

8. In a telephone system having lines, a connecting circuit for the lines, said connecting circuit terminating in a pair of connecting plugs, an operator's telephone receiver normally connected with a contact of each of the said connecting plugs, a relay associated with each of the said connecting plugs for disconnecting the said receiver from the said contacts of the respective connecting plugs when the latter are connected with respective lines, and an impedance coil connected from the said receiver to a source of electricity, whereby a test circuit is normally established from the said contacts of the respective connecting plugs through contacts of the respective said relays, the operator's telephone receiver, and the said impedance coil, for purposes substantially as described.

9. In a telephone system having lines, a plug-cord connecting circuit for the lines, an operator's telephone set including a receiver, normally connected with the plug-cord circuit, a relay associated with each of the connecting plugs of a pair for disconnecting the operator's telephone set from the respective connecting plugs when the latter are connected with respective lines, whereby a busy-test circuit is normally established from a conductor of either said connecting plug through contacts of the respective relays and the operator's telephone receiver, for purposes substantially as described.

10. In a telephone system having lines, a plug-cord connecting circuit for the lines, an operator's telephone normally connected with the plug-cord circuit, and means for disconnecting the operator's telephone from the respective connecting plugs when the latter are connected with lines, whereby a busy-test circuit is normally established from a conductor of either said connecting plugs through the operator's telephone, for purposes substantially as described.

11. A telephone system having lines, a plug-cord connecting circuit for the lines, a source of electricity, a plurality of connection terminals for each of the lines, each connection terminal having a test contact, the test contacts for each of the lines being connected together and normally disconnected from the said source of electricity but adapted to be connected therewith, an operator's telephone normally connected with the plug-cord connecting circuit, and a relay for disconnecting the operator's telephone from a connecting plug when the latter is connected with a line, whereby a test circuit is normally established from a conductor of said connecting plug through a contact of the said relay and the operator's telephone, the said test circuit cooperating with the line test contacts for purposes substantially as described.

12. A telephone system having lines, a plug-cord connecting circuit for the lines, a source of electricity, a plurality of connection terminals for each of the lines, each connection terminal having a test contact, the test contacts for each of the lines being connected together and normally disconnected from the said source of electricity but adapted to be connected therewith, an operator's telephone normally connected with the plug-cord connecting circuit, and means for disconnecting the operator's telephone

from a connecting plug when the latter is connected with a line, whereby a test circuit is normally established from a conductor of said connecting plug through the operator's telephone, the said test circuit cooperating with the line test contacts for purposes substantially as described.

13. In a telephone system having lines, said lines having suitable test contacts, a plug-cord connecting circuit for the lines, an operator's telephone, a supervisory signal, and a pair of relays for controlling the said supervisory signal, one of the said relays normally connecting the operator's telephone with a connecting plug and being adapted to break such connection when the said plug is connected with a line, whereby a test circuit is established from a conductor of the said connecting plug through a contact of the last mentioned relay and the operator's telephone, the said test circuit cooperating with the line test contacts for purposes substantially as described.

As inventor of the foregoing I hereunto subscribe my name in the presence of two subscribing witnesses this 17th day of February, 1908.

ELMER R. CORWIN.

Witnesses:

FREDERICK R. PARKER,
FRANK J. RYAN.