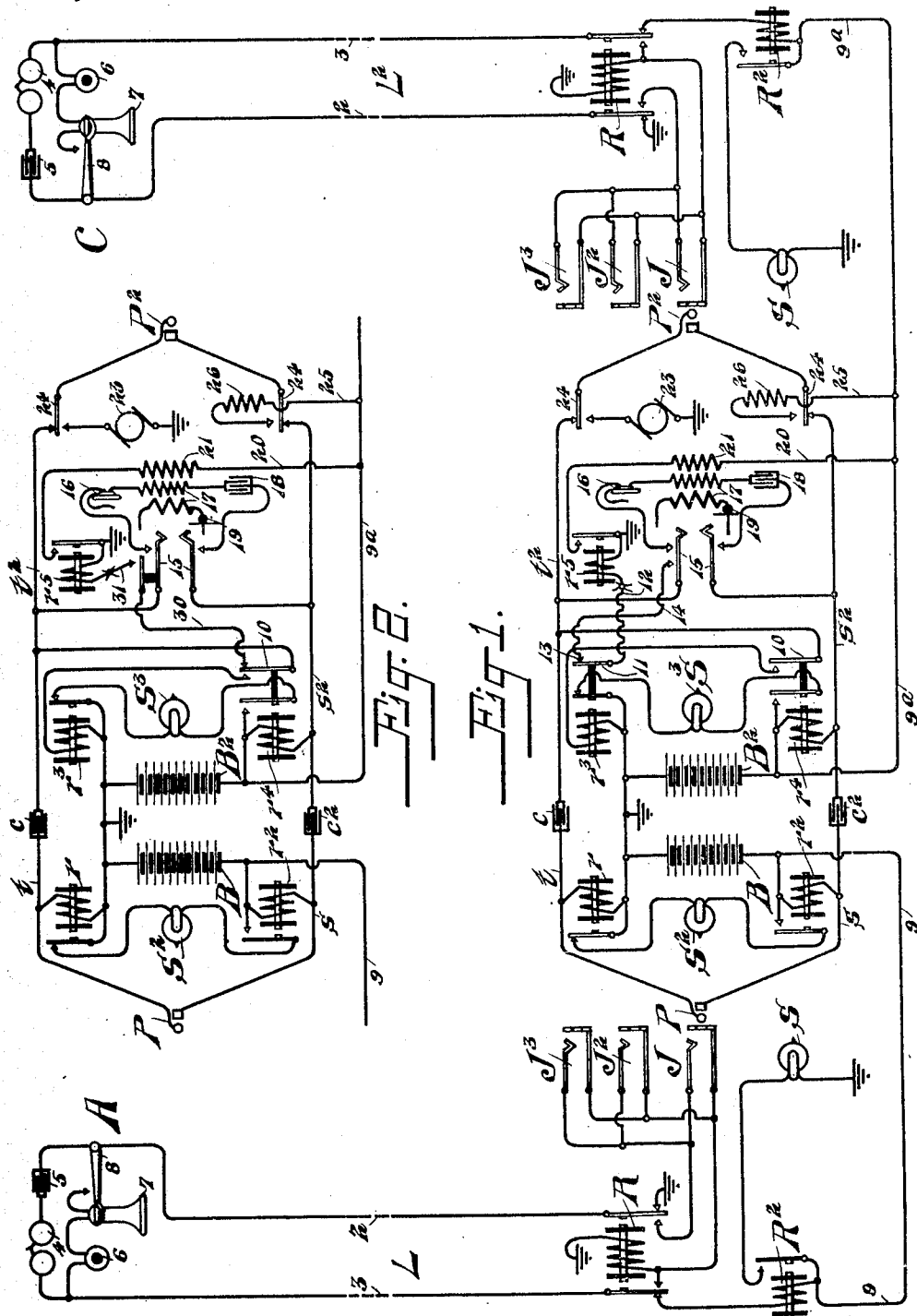


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 TESTING SYSTEM FOR TELEPHONE LINES.  
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916,117.

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Witnesses.  
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# UNITED STATES PATENT OFFICE.

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## TESTING SYSTEM FOR TELEPHONE-LINES.

No. 916,117.

Specification of Letters Patent. . . Patented March 23, 1909.

Application filed June 29, 1903. Serial No: 163,614.

*To all whom it may concern:*

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and resident of Chicago, county of Cook, and State of Illinois, have invented a new and useful Improvement in Testing Systems for Telephone-Lines, of which the following is a specification.

My invention relates to improvements in testing systems for telephone lines, and consists in means whereby the test relay of the system is normally separated or isolated from the operator's connective means, whereby in case of the short circuiting of one or more of the cords or connective means, or if there is general leakage in all of the said means at some particular operator's position, the said test relay is not deranged, and is adapted for proper operation with any of the switchboard cords or operator's connective means that is in proper working condition.

In my application filed June 29th, 1903, Serial No. 163,613, I show and describe means for thus accomplishing the isolation of the testing device in which the testing strand of the cord circuit is normally severed and is completed for conversation when the connection is established with the called line.

In my present arrangement I do not sever the said strand of the cord circuit, but I open normally the connection of said strand with ground or common return and connect therewith the test device preferably through contacts of the listening key.

Other features of the invention are brought out in the detailed description and claims.

My invention is illustrated in the accompanying drawing in which—

Figure 1, is a diagram of a telephone system embodying my improvements, and Fig. 2 is a diagram of a modification of same.

Referring to Fig. 1, L and L<sup>2</sup> indicate two subscribers' lines extending in two limbs 2 and 3 from their respective substations to the central office. At each substation a call bell 4 and a condenser 5 are located in a permanent bridge of the line conductors, while a transmitter 6 and a receiver 7 are included in another bridge which is normally open at the switch-hook 8.

At the central office each line is fitted as usual with a line signal S and an answering jack J and a plurality of multiple jacks J<sup>2</sup> and J<sup>3</sup>. The line conductor 2 is normally grounded, but is adapted during conversa-

tion to be connected with the tip conductor of the jack section of the line; while the sleeve conductor 3 of the telephone line is normally connected with the common conductor 9 or 9<sup>a</sup> extending to the live pole of the common battery B or B<sup>2</sup>. These line conductors include the winding of the line relay R<sup>2</sup> which controls the local circuit of the line signal S. The cut-off relay R has its winding connected to ground from the sleeve conductor of the jack section of the telephone line.

The operator's cord circuit comprises an answering plug P and a calling plug P<sup>2</sup>, having tip and sleeve contacts adapted to register with the corresponding contacts of the spring jacks of the lines when the plugs are inserted therein. The tip contacts of the said plugs are connected together by the flexible strands *t* and *t*<sup>2</sup> and the interposed condenser *c*, while the sleeve contacts of said plugs are joined by the similar strands *s* and *s*<sup>2</sup> and the interposed condenser *c*<sup>2</sup>. The supervisory relays *r* and *r*<sup>2</sup> are connected across the answering end of the cord circuit upon the opposite sides of the battery B and control the local circuit of the supervisory signal S<sup>2</sup> associated with the answering plug. A similar pair of supervisory relays *r*<sup>3</sup> and *r*<sup>4</sup> are together with the battery B<sup>2</sup> associated with the calling end of the cord circuit, the relay *r*<sup>4</sup> being directly connected between the live pole of said battery B<sup>2</sup> and the sleeve strand *s*<sup>2</sup>, while the tip relay *r*<sup>3</sup> has its connection between the tip strand *t*<sup>2</sup> and the grounded pole of the battery B<sup>2</sup> completed through normally open contacts 10 of the said sleeve relay *r*<sup>4</sup>. These relays together control the local circuit of the supervisory lamp S<sup>3</sup> associated with the calling plug P<sup>2</sup>. The high resistance and high impedance test relay *r*<sup>5</sup>, which is preferably common to all of the cord circuits at each operator's position, is connected between ground and the movable contact 11 of the tip relay *r*<sup>3</sup> by conductor 12, the normal contact 13 of said movable contact being joined by the conductor 14 with a normally open contact of the tip listening key spring 15. The said test relay *r*<sup>5</sup> is therefore normally separated or isolated from the strands of the cord circuit, but when the listening key 15 is operated to connect the operator's set with the cord circuit, said relay is thereby connected with the tip strand *t*<sup>2</sup> of the cord circuit. This operator's set comprises a head

telephone 16, an induction coil 17 and a condenser 18, which are adapted to be connected in a bridge of the cord circuit by the listening key springs 15, the operator's transmitter 19 being charged from any suitable current source. The test relay  $r^5$  is adapted when operated to complete a path for current from battery  $B^2$  over conductor  $9^a$  and through conductor 20 including the third winding 21 of the operator's induction coil. A ringing generator 23 is adapted to be connected with the tip strand  $t^2$  of the cord circuit when the ringing key springs 24 are operated, the forward portion of the sleeve strand being connected directly with the battery  $B^2$  by means of the sleeve ringing spring 24 over the conductor 25 including a suitable resistance 26.

In the operation of the system, the subscriber A, for example, takes up his receiver, thereby completing a path for current from the battery B over his line and through the line relay  $R^2$ , which is energized to close the local circuit of the line signal S. Upon observing this signal the operator connects her telephone with the cord circuit and after learning the number of the wanted party's line, tests the line in the usual manner to determine its idle or busy condition. The operation of her listening key automatically completes the test relay circuit. If the line is idle the test rings thereof are connected with ground through the cut-off relay  $R^2$  and since the tip of the testing plug is likewise connected with ground through the said test relay no flow of current results and no click is received. The operator is thus made aware of the fact that the line is idle. If the line is busy, however, the said test rings are connected with the live pole of one of the batteries B or  $B^2$  and a path for current is completed over the said tip strand  $t^2$ , the tip spring 15 of the listening key, conductor 14, contacts 13 and 11 of the tip supervisory relay  $r^3$ , conductor 12 and the high resistance and high impedance test relay  $r^5$  to ground. This relay is adjusted to respond to the flow of current over this path, and attracts its armature to thereby close the path for current through the tertiary winding 21 of the operator's induction coil. The closing of this path therefore causes a click in the operator's receiver, and indicates to her that the line is busy.

Assuming that the line is found idle, the calling plug  $P^2$  is inserted in one of the multiple jacks of the line, and the ringing key 24 is operated to connect the calling generator 23 in circuit. During ringing current flows from the battery  $B^2$  over conductors  $9^a$  and 25, and through the cut-off relay of the called line to maintain the same operated. After the subscriber has been called and before his response, the sleeve supervisory relay  $r^4$  is operated to close the local circuit of the supervisory signal  $S^3$  which is

lighted to indicate the fact that the subscriber has not yet responded. Said relay  $r^4$  also closes the path for current through the tip strand  $t^2$ , so that when the subscriber does respond a complete path for current over the telephone line and through said relay  $r^3$  is provided. When said relay  $r^3$  operates the local circuit of the supervisory signal  $S^3$  is opened to extinguish the same. The operation of this relay also disconnects the test relay  $r^5$ , whereby should it become necessary for the operator to connect her instrument with the cord circuit during conversation the test relay is not again connected therewith and the talking circuit is not opened. During conversation the batteries B and  $B^2$  are furnishing current over the telephone lines for the operation of the substation transmitters, while the voice currents are inductively transmitted from one line to the other through the condensers  $c$  and  $c^2$  in the cord circuit strands. At the termination of the conversation when the subscribers return their receivers to the hooks, current is cut off from the tip supervisory relays  $r$  and  $r^3$  which are deenergized to close the local circuits of the supervisory signals. These signals are therefore lighted to indicate to the operator that the conversation has terminated when the connection may be taken down and all parts returned to normal condition. It is thus seen that the test relay is normally disconnected from the operator's cord circuit and if a general leakage should exist in the cord circuits, or if one of the cord circuits should become short circuited, the test relay is not operated thereby. The cord circuits that are not so disabled may therefore be used with the test relay in the ordinary manner.

Fig. 2 shows a similar arrangement except that a conductor 30 extends from the back contact of spring 10 of relay  $r^4$  to normally open contacts of the listening key 15 and these are joined by conductor 31 with the ungrounded terminal of the test relay  $r^5$ .

What I claim is:

1. In a telephone system, the combination with a cord circuit having a complete testing strand, of a test relay normally isolated therefrom, a test indicating device controlled by said relay, a listening key for connecting said relay with said strand during testing, and a supervisory relay for automatically disconnecting said relay from said strand during conversation, substantially as described.

2. In a telephone testing system, the combination with a cord circuit having a complete testing strand, of a test relay normally isolated therefrom and from the operator's listening set, a test indicating device controlled by said relay, and means for manually connecting said relay and said set with said strand during testing and further means

for preventing the connection of said relay during conversation, substantially as described.

3. In a telephone testing system, the combination with a cord circuit having a complete testing strand, of a test relay normally isolated therefrom, a test indicating device controlled by said relay, a listening key to connect said relay with said strand during testing, said relay being independent of the operator's listening set, and a supervisory relay associated with the cord circuit for automatically disconnecting said test relay from said strand during conversation.

4. In a telephone testing system, the combination with a cord circuit having a complete testing strand, of a test relay normally isolated therefrom, a test indicating device controlled by said relay, and means for connecting said relay with said strand during testing and electromagnetic means for disconnecting said relay during conversation, substantially as described.

5. In a telephone testing system, the combination with a cord circuit having a complete testing strand, of a test relay normally isolated therefrom, a test indicating device controlled by said relay, means for connecting said relay with said strand for testing, and a supervisory relay associated with the cord circuit for automatically disconnecting it during conversation, substantially as described.

6. In a telephone testing system, the combination with a cord circuit having a complete testing strand, of a test relay normally isolated therefrom, a test indicating device controlled by said relay, means for connecting said relay with said strand for testing, and electro-magnetic means for completely disconnecting said relay from said testing strand during conversation, substantially as described.

7. In a telephone testing system, the combination with a connecting plug and a busy testing strand associated therewith, of a test relay, said relay being independent of the operator's listening set, means for manually connecting said relay with the terminal of said plug and at the same time leaving the tip talking strand intact, a test responsive device controlled by the relay, and means actuated during conversation for disconnecting the said relay, substantially as described.

8. In a telephone testing system, the combination with a connecting plug and the strands associated therewith, of a test relay and a responsive device controlled thereby, means for normally connecting said relay with one terminal of the plug and at the same time leaving the talking strand associated with said terminal intact, and an electro-magnetic device controlled by current over one strand for disconnecting said

relay during conversation, substantially as described.

9. In a telephone testing system, the combination with telephone lines having testing contacts connected directly with one side of the talking circuit during conversation, of an operator's connective circuit having its talking strands permanently completed so far as the testing apparatus is concerned, a central source of current associated with the lines for talking purposes, a testing apparatus comprising a testing terminal to cooperate with one of said contacts in testing, a high resistance and test responsive device in circuit with said terminal, and means to automatically remove the same upon the connection of the operator's connective circuit with the line, substantially as described.

10. In a telephone testing system, the combination with telephone lines having testing contacts connected directly with one side of the talking circuit during conversation, of an operator's connective circuit having normally complete talking strands, a central source of current associated with the lines, said source being used for talking purposes, testing apparatus comprising a testing terminal to cooperate with one of said contacts, a test responsive device in circuit with said terminal, the test circuit being of high resistance and impedance to prevent a large or sudden variation on the line when tested, a supervisory relay associated with said testing terminal but normally disconnected therefrom, and means to automatically cut out such resistance and to connect said supervisory relay with the said terminal during conversation, substantially as described.

11. In a telephone testing system, the combination with telephone lines having testing contacts connected directly with one side of the talking circuit during a connection, of an operator's connective circuit to furnish current for talking purposes associated with the lines, a testing apparatus comprising a testing terminal to cooperate with the said testing contacts of the lines, said testing terminal being normally connected with a complete talking strand, a high resistance testing device connected with said testing terminal to prevent an excessive flow of current therethrough when testing, a supervisory relay associated with the strand of the operator's connective circuit connected with said test terminal but normally disconnected therefrom, and a relay operated over the other strand of the cord circuit actuated during a conversation to remove said resistance and connect said relay to its circuit, substantially as described.

12. In a telephone testing system, the combination with telephone lines having testing contacts therefor connected directly with one side of the talking circuits during conversation, of a plurality of operator's con-

nective circuits, and a central source of current associated therewith and adapted to furnish current for talking purposes, testing apparatus comprising a testing circuit common to said connective circuits, said circuit being of high resistance and impedance, a test responsive device in said circuit, a supervisory relay associated with each connective circuit but disconnected therefrom, and means to automatically disconnect said testing circuit when the operator's connective circuits are in use for conversation and to connect their respective supervisory relays, substantially as described.

13. In a telephone testing system, a telephone line circuit provided with one or more spring jack switches or connection terminals, one or each of said switches being provided with a testing contact, said testing contact being connected to one side of the talking circuit of said line when switched for conversation, an operator's connective circuit having complete talking strands terminating at one end in a plug provided with contact terminals adapted to register with the contacts of said spring jack switches, and at the other end in a plug provided with contact terminals adapted to register with the contacts of a calling line, a source of current associated with said cord circuit and adapted to furnish current for talking for said line when switched for conversation, a supervisory signal associated with said cord circuit and adapted to be operated when connection is made with a line, and a relay for rendering said signal inoperative controlled by a switch at the distant end of the line circuit, said switch serving to allow the flow of current over said line, a test responsive device associated with said cord circuit and operated over a circuit of relatively high resistance, said circuit being completed between the testing contact of the test plug and the testing contact of said line terminal when the line is tested for conversation, an electro-magnetic device associated with said cord circuit and controlling the circuit of said supervisory signal at one point and adapted to operate during conversation and to complete the circuit for said supervisory relay, and means to disconnect said test receiving circuit during conversation whereby a line circuit is subject to no undue disturbance when the test is made, substantially as described.

14. In a telephone system, the combination with telephone lines, each having a testing terminal, of a cord circuit to connect said lines for conversation, a supervisory relay for the cord circuit actuated when a connection is made with a telephone line,

a second supervisory relay for the cord circuit actuated when the line is closed at the substation, a normally complete tip strand for said cord circuit, a test responsive device connected therewith for testing, and contacts of the first supervisory relay normally isolating the second supervisory relay from the testing strand of the cord circuit, whereby the testing current will not be shunted away from said test responsive device, substantially as described.

15. In a telephone system, the combination with telephone lines, each having a test terminal, of a cord circuit to connect said lines for conversation, said cord circuit having a normally complete tip strand so far as conversation is concerned, a supervisory signal for the cord circuit, a supervisory relay actuated when a connection is made with a telephone line to display said signal, a second supervisory relay actuated when the line is closed at the substation to efface said signal, the latter relay being adapted to furnish energizing current to the line, a test responsive device connected with the tip strand of the cord circuit for testing and contacts of the first supervisory relay normally isolating the second supervisory relay from the tip strand of the cord circuit, whereby the testing current will not be shunted away from said responsive device, substantially as described.

16. In a telephone system, the combination with a cord circuit having a complete tip strand, a supervisory relay having its coil connected therewith during conversation, a test receiving device connected with said tip strand for testing, the coil of said supervisory relay being disconnected from said tip strand during testing, substantially as described.

17. In a telephone system, the combination with a cord circuit, of a condenser dividing a strand of said cord circuit into two parts, one of said parts forming a testing conductor, a source of current, an impedance coil connected between said source and said testing conductor during conversation, a test responsive device connected with said testing conductor for testing, said impedance coil being disconnected from said testing conductor during testing, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 12th day of June 1903.

WILLIAM W. DEAN.

Witnesses:

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EVA A. GARLOCK.