

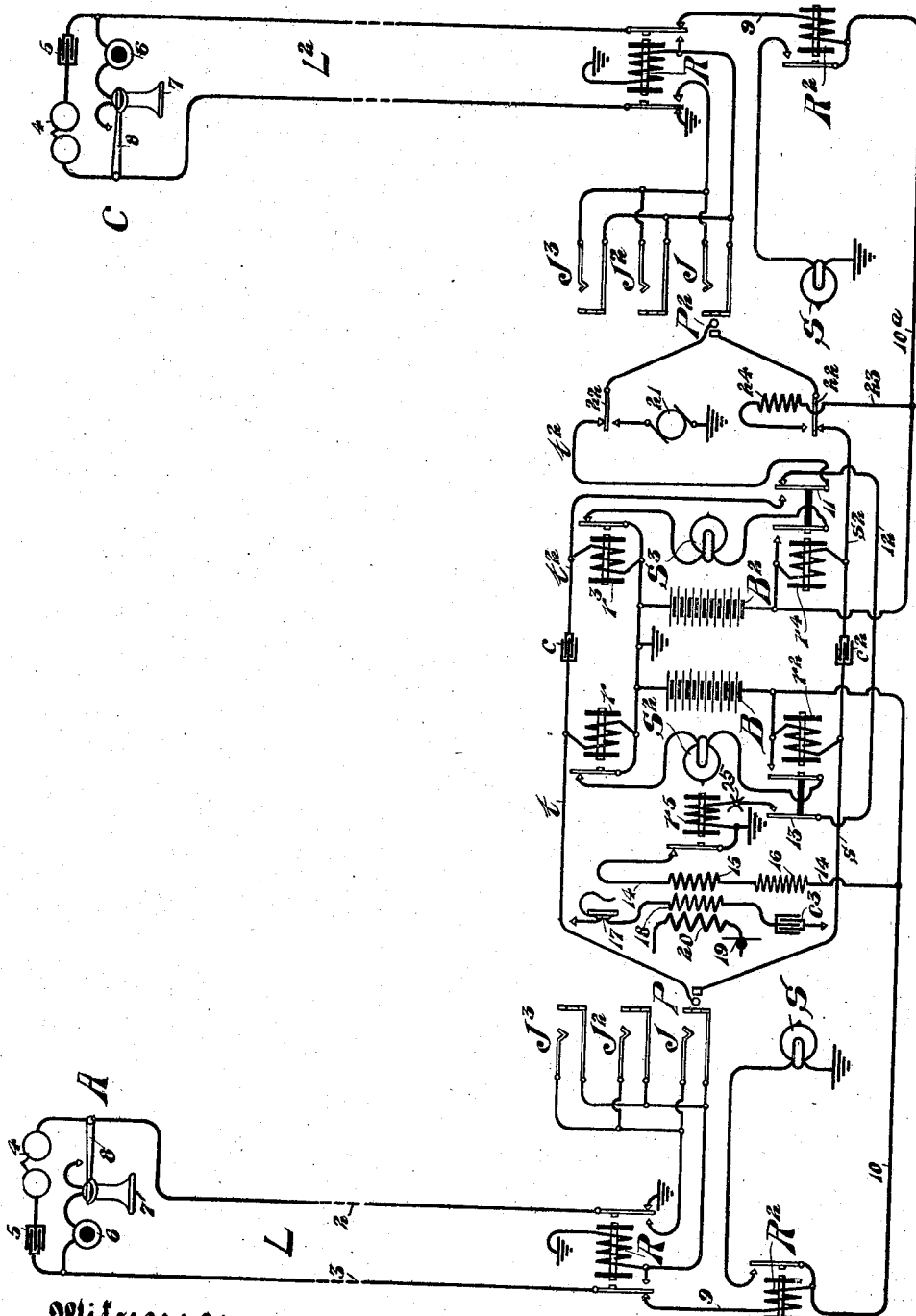
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W. W. DEAN.

TESTING SYSTEM FOR TELEPHONE LINES.

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**Witnesses.**

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# UNITED STATES PATENT OFFICE.

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## TESTING SYSTEM FOR TELEPHONE-LINES.

No. 867,349.

Specification of Letters Patent.

Patented Oct. 1, 1907.

Application filed July 27, 1903. Serial No. 167,063.

*To all whom it may concern:*

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

My invention relates to testing systems for multiple board telephone lines, it being one object of my invention to provide a testing system in which the test responsive device is normally isolated from the cord circuits, whereby in case of the short circuiting of some of the cord circuits at an operator's position, or of a general leakage, the whole position is not thrown out of use.

A second object is to provide a testing system in which the response of the testing device is instantaneous, whereby no time is lost in making the test.

My invention is illustrated in the accompanying drawing in which the figure is a diagram of a telephone system.

In the figure, L and L<sup>2</sup> indicate subscribers' lines extending in two limbs 2 and 3 from their respective substations A and C to the central office where they are fitted with the usual multiple jacks or connection terminals, signals and cooperating relays. At each substation a signaling bell 4 and a condenser 5 are connected in a permanent bridge of the line conductors, while a transmitter 6 and receiver 7 are in a second bridge that is normally open at the switch hook 8. This apparatus is intended merely to typify any desired substation outfit for it is apparent that any suitable apparatus may be employed.

The line conductor 2 is normally connected to ground but is adapted when the cut-off relay R is operated to be disconnected from ground and to be connected with the tip conductor of the jack section of the line. The line conductor 3 is normally connected with a conductor 9 including the winding of the line relay R<sup>2</sup> and is in turn joined to the battery lead 10 connected with the live pole of the central common battery B. When the said cut-off relay is operated the said line conductor 3 is disconnected from the conductor 9 and joined to the sleeve conductor of the section of the line leading to the multiple jacks J, J<sup>2</sup> and J<sup>3</sup>. The line relay R<sup>2</sup> controls the local circuit of the line signal S.

The operator's cord circuit, of which only one is shown, includes an answering plug P and a calling plug P<sup>2</sup> having tip and sleeve contacts adapted to register respectively with the corresponding contacts of the spring jacks of the telephone lines. The tip contacts of these plugs are joined together by the flexible strands *t* and *t*<sup>2</sup> and the interposed condenser

*c*, while their sleeve contacts are similarly united through the 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 either side of the battery B and together control the local circuit of the supervisory signal S<sup>2</sup> associated with the answering plug, while similar supervisory relays *r*<sup>3</sup> and *r*<sup>4</sup> are connected across the calling end of the cord circuit upon the opposite sides of the common battery B<sup>2</sup>, and likewise control the local circuit of the supervisory signal S<sup>3</sup> associated with the calling plug P<sup>2</sup>. The tip strand *t*<sup>2</sup> of the cord circuit is normally open at spring 11 of the supervisory relay *r*<sup>4</sup>, said spring being connected with the forward portion of said strand and normally connected with a conductor 12 leading to an auxiliary spring 13 of the supervisory relay *r*<sup>2</sup>. The forward contact of this spring is connected with the high resistance and high impedance test relay *r*<sup>5</sup> that is preferably common to all of the cord circuits at each operator's position of the switchboard as is indicated by the branching lines at 25. The contacts of this test relay *r*<sup>5</sup> are normally closed and complete a circuit by means of conductor 14 through the tertiary winding 15 of the operator's induction coil, said conductor also including preferably a high resistance 16 and being connected in any desired manner with the live pole of battery B or B<sup>2</sup>, in this instance with B. The operator's head receiver 17, the secondary 18 of her induction coil and the condenser *c*<sup>3</sup> are adapted to be connected across the answering end of the cord circuit by means of any suitable listening key. Her transmitter 19 and the primary winding 20 of her induction coil are charged from any suitable source of current and which may be the battery B or B<sup>2</sup>. A ringing generator 21 is adapted to be connected with the tip strand of the cord circuit by the operation of the listening key springs 22, the sleeve conductor at the same time being connected with the live pole of the battery B<sup>2</sup> through the conductor 23, including a suitable resistance 24, and common conductor 10<sup>a</sup>.

In the operation of the system, the subscriber A for example takes up his receiver, thereby completing a path for current over the telephone line from the battery B and operating the line relay R<sup>2</sup>. This relay closes the local circuit of the line signal S which is lighted to indicate the subscriber's call. Upon observing the signal the operator inserts the answering plug P of her cord circuit in the answering jack J of the calling line and connects her head telephone with the cord circuit to receive the order. The insertion of the plug P permits current to flow from the battery B over the strand *s* of the cord circuit and through the cut-off relay R to ground, which relay is actuated to render

the line signal inoperative and to place the line in condition for conversation. At the same time supervisory relay  $r^2$  is actuated to close the local circuit of the supervisory lamp  $S^2$  but owing to the fact that the subscriber's telephone is off its hook current from the battery B now flows over the metallic telephone line and through the tip supervisory relay  $r$  which is actuated to open the local circuit of the lamp  $S^2$  thereby preventing its operation. The actuation of supervisory relay  $r^2$  also completes through its spring 13 the portion of the testing circuit of the common test relay  $r^5$  that is individual to the cord circuit now being used and which includes the conductor 12. Upon learning the line wanted, it is tested in the usual manner by touching the tip of the calling plug  $P^2$  to the test ring of one of the multiple jacks of the wanted line. If busy, the said test rings are connected with the live pole of either the battery B or  $B^2$  through the sleeve strand of the connected cord circuit and a flow of current takes place over the forward portion of the tip strand  $t^2$  of the testing cord, through spring 11 of relay  $r^4$ , conductor 12, spring 13 of relay  $r^2$  and thence through the high resistance test relay  $r^5$  to ground. This relay is of such resistance and impedance as to prevent a large or sudden variation of current upon the tested line so that the subscribers are not annoyed by the operation of testing. The test relay responds to the current over this path and breaks the local circuit that is normally closed from the live pole of battery B over conductors 10 and 14 and to ground through the normally closed contacts of the test relay  $r^5$ . The breaking of this local circuit which includes the tertiary winding 15 of the operator's induction coil causing a click in the operator's receiver and she is thus informed that the wanted line is busy. If the wanted line is idle, however, the said test rings are grounded and since the tip of the testing plug is likewise grounded no flow of current takes place and the operator knows that the line is idle. Upon finding the line idle the calling plug is inserted and the ringing key operated to call the subscriber. The operation of this key connects the ringing generator 21 with the tip strand of the plug which sends out current over the metallic telephone line with return through the conductor 23 and battery  $B^2$ . Steady current over this latter path suffices at the same time to maintain the cut-off relay R of the wanted line operated. As soon as the ringing key has been returned to normal position, the relay  $r^4$  is energized and serves to cut-off the test relay through its spring 11 and to complete the strand  $t^2$  for talking. Simultaneously the local circuit of supervisory lamp  $S^3$  is closed and since the tip supervisory relay  $r^3$  is not yet operated the lamp  $S^3$  is lighted to indicate that the called subscriber has not yet responded. Upon the response of the called subscriber current from the battery  $B^2$  flows over the metallic line thus operating the relay  $r^3$  which extinguishes the supervisory lamp  $S^3$ .

During conversation the batteries B and  $B^2$  are sending current out over the respective lines for the operation of the transmitters at the substations, and at the termination of the conversation the return of the subscribers' receivers to their hooks deenergizes the tip supervisory relays  $r$  and  $r$  which close the circuits of the supervisory signals  $S^2$  and  $S^3$  thus operating them and indicating to the operator that the conversation has terminated. She accordingly takes down the connection

and restores all parts to normal condition. Under normal conditions therefore the test relay  $r^5$  is disconnected from all of the cord circuits at the operator's position so that in case of an accidental short circuiting of the strands of the cord circuit or of general leakage at the operator's position the said test relay  $r^5$  is not normally actuated but is in condition to respond to any cord circuit that is in proper working condition when a connection is established. The closed testing circuit including the normal contacts of the test relay  $r^5$  causes a quicker test than where said circuit is normally open since the armature of the said relay is not required to travel any distance to close the testing circuit. It is also more positive since the breaking of the circuit causes the test in place of the making of the circuit as under ordinary conditions and which might be hindered by means of dust or dirt upon the contacts of the relay or by other obstructions. Again the breaking of the circuit causes a more distinctive sound than the other method and which is more readily distinguished from ordinary noises.

It is obvious that various alterations and changes may be made in my invention without departing from its scope or principle.

Having thus described my invention what I claim is:

1. In a telephone system, the combination with subscribers' lines, of a plurality of cord circuits, a test relay and an operator's telephone set common to said cord circuits, a circuit inductively associated with the circuit of the operator's telephone set, and means controlled by said relay for breaking said circuit in testing, to thereby cause a sound in the operator's telephone, substantially as described. 90
2. In a telephone testing system, the combination with a plurality of cord circuits, of a test responsive device common to said cord circuits, said device being normally isolated from said circuits through the contacts of the answering supervisory relay actuated over a portion of the talking circuit, substantially as described. 100
3. In a telephone testing system, the combination with a plurality of cord circuits, of a high resistance test relay common to said cord circuits but normally isolated therefrom, and electro-magnetic means operated by the connection of the cord circuit with the calling line to connect said device with the cord circuit employed for the connection, substantially as described. 105
4. In a telephone system, the combination with a plurality of cord circuits, of a test responsive device common to said cord circuits, a relay adapted to be actuated by current over one of the talking strands of the cord circuit during connection, and contacts of said relay normally isolating said test responsive device from the cord circuit, substantially as described. 110
5. In a telephone system, the combination with a plurality of cord circuits, of a test responsive device common to said cord circuits, a sleeve supervisory relay associated with the answering end of the cord circuit, and contacts of said relay in the circuit of said test responsive device, substantially as described. 120
6. In a telephone testing system, the combination of a plurality of cord circuits, of a test responsive device common to said cord circuits, a sleeve supervisory relay associated with the calling end of the cord circuit, a relay associated with the other end of the cord circuit, said responsive device having its circuit controlled through the contacts of said relays in series, substantially as described. 130
7. In a telephone system, the combination with subscribers' lines, a plurality of cord circuits to establish connections therewith for conversation, a test relay and an operator's telephone set common to said cord circuits, a circuit inductively associated with the circuit of the operator's set and containing closed contacts of said relay whereby in testing said relay is adapted to break said 135

circuit to cause a sound in the operator's telephone, substantially as described.

8. In a telephone circuit, the combination with a plurality of subscribers' lines, of a plurality of cord circuits to establish connections therewith for conversation, a test relay and an operator's telephone set common to said cord circuits, said operator's telephone set including an induction coil having a tertiary winding, a local circuit including said tertiary winding and normally-closed contacts of said relay, whereby in testing said relay is adapted when operated to break said local circuit to inductively cause a sound in the operator's telephone receiver, substantially as described.

9. In a telephone system, the combination with a plurality of cord circuits, of a high resistance test relay for said cord circuits, said relay being normally isolated from the cord circuits by contacts of the sleeve answering supervisory relay, substantially as described.

10. In a telephone system, the combination with a plurality of cord circuits, of a normally isolated high resistance test relay for said cord circuits, means to automatically connect said relay with a cord circuit by the insertion of the answering plug in the jack of the calling line, and means to again sever the connection of said relay from the cord circuit by the insertion of the calling plug in the jack of the called line, substantially as described.

11. In a telephone system, the combination with a plurality of cord circuits, of a high resistance test relay normally isolated from the cord circuit, and means independent of the position of the listening key for connecting said relay with the cord circuit, and further means for again isolating the test relay when connection is established with the called line, substantially as described.

12. In a telephone system, the combination with a plurality of cord circuits having a normally intercepted tip strand, a test conductor normally connected with the tip of the calling plug, a high resistance test relay normally isolated from said test conductor, means to connect said test conductor with the high resistance relay before testing the condition of a telephone line, and means to sever the connection of the high resistance relay and to complete the continuity of the tip strand of the talking circuit when a connection is established with the calling line, substantially as described.

13. In a telephone testing system, the combination with a plurality of cord circuits, of a test responsive device common to said cord circuits, said responsive device having its circuit completed through contacts of relays one actuated over a portion of the talking circuit of one end of the cord circuit and the other over a portion of the talking circuit of the other end of the cord circuit, substantially as described.

14. In a telephone testing system, the combination with a plurality of telephone lines, of a plurality of cord circuits to establish connections therewith for conversation, a central source of common current associated with said cord circuits and adapted to be included in the telephone lines during connections to furnish current for conversation, a testing conductor common to said cord circuits but normally disconnected therefrom, means associated with the answering ends of said cord circuits for automatically connecting said conductor with any of said cord circuits for the purpose of making a busy test, and means associated with the calling end for disconnecting the testing conductor without disconnecting the operator's listening set, substantially as described.

15. In a telephone testing system, the combination with a plurality of telephone lines, of a plurality of cord circuits to establish connections therewith for conversation, a central source of common current associated with said cord circuits and adapted to be included in the telephone lines during connections to furnish current for conversation,

a testing conductor out of the electric connection with the operator's communicating set common to said cord circuits but normally disconnected therefrom, and means for automatically connecting said conductor with any of said cord circuits, said means being rendered operative by the act of making a connection with a calling subscriber, substantially as described.

16. In a telephone testing system, the combination with a plurality of telephone lines, of a plurality of cord circuits to establish connections therewith for conversation, a central source of common current associated with said cord circuits and adapted to be included in the telephone lines during connections to furnish current for conversation, a testing conductor common to said cord circuits but normally disconnected therefrom, and electromagnetic means associated with each cord circuit and energized by current over a portion of the talking circuit and actuating contacts in the circuit of said conductor for connecting it with the corresponding cord circuits when a connection is established thereby with a calling subscriber's line, substantially as described.

17. In a telephone testing system, the combination with a plurality of telephone lines, of a plurality of cord circuits to establish connections for conversation with said lines, supervisory relays associated with said cord circuits and controlling supervisory signals, a testing conductor common to said cord circuits normally isolated therefrom and from the operator's communicating set, and means for automatically connecting said conductor with any of the cord circuits through the medium of said supervisory relays, substantially as described.

18. In a telephone testing system, the combination with a plurality of telephone lines, of a plurality of cord circuits to establish connections for conversation with said lines, supervisory relays associated with said cord circuits and controlling supervisory signals, a testing conductor common to said cord circuits normally isolated therefrom, a testing relay in circuit with said conductor, and means for connecting said conductor and relay with any of the cord circuits through the medium of supervisory relays when a connection is established with a calling line, substantially as described.

19. In a telephone system, the combination with a plurality of telephone lines, of a plurality of cord circuits adapted to be connected therewith for conversation, an operator's communicating set, a testing conductor common to said cord circuits, a supervisory relay associated with each end of the cord circuit to suitably operate or control the corresponding supervisory signals, said common conductor being normally isolated from the cord circuits but adapted to be connected therewith by the operation of the supervisory relay at the answering end of the cord circuit and to be again disconnected from the cord by the relay at the opposite end when energized without preventing the connection of the operator's communicating set with the cord circuit at any time, substantially as described.

20. In a telephone testing system, the combination with a cord circuit, of a testing device therefor, an electromagnetic winding energized over a portion of the talking circuit when a connection is established by the cord circuit with a calling line to connect said testing device therewith, a second electromagnetic winding to disconnect said device when the cord circuit is connected with the called subscriber, an operator's listening set, and means to connect said set with the cord circuit during a complete connection, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 21st day of July, 1903.

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,  
GAZELLE BEDER.