

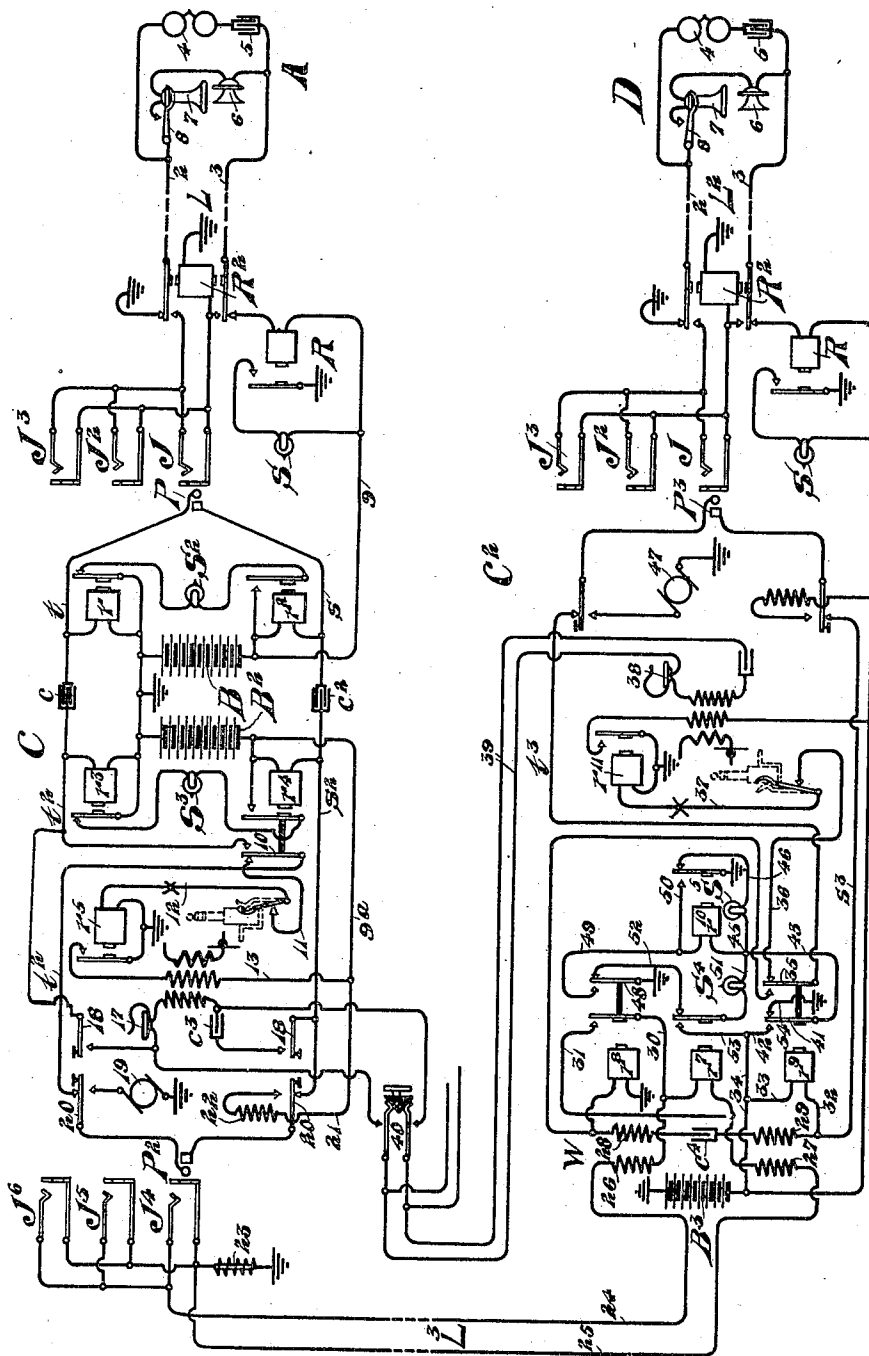
No. 838,525.

PATENTED DEC. 18, 1906.

W. W. DEAN.

TESTING SYSTEM FOR TELEPHONE LINES.

APPLICATION FILED JUNE 29, 1903.



Witnesses.

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TESTING SYSTEM FOR TELEPHONE-LINES.

No. 838,525.

Specification of Letters Patent.

Patented Dec. 18, 1906.

Application filed June 29, 1903. Serial No. 163,616.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and a 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 means for connecting the common portion of a busy testing-circuit to the testing-strand of an operator's connective means when it is desired to use the same for testing.

I accomplish the desired end in this invention by providing a plug-seat switch for a plug of the connecting means and include the normally open contacts of said switch in the testing-conductor, whereby when the plug is out of its seat the testing-circuit is completed at that point and a test may be made. The testing-plug is preferably so provided with the seat whereby when lifted therefrom the circuit is completed and the said plug may be used for testing.

My invention is illustrated in the accompanying drawing, in which the figure is a diagram of a telephone system including subscribers' lines terminating at different central offices and operator's connective means to establish connections at one of said offices, as well as between the lines terminating at the different offices.

L indicates a telephone-line extending in two limbs 2 and 3 from the substation to the central office C, where it is fitted, as is usual, with a line-signal S, an answering-jack J, and a plurality of multiple jacks, such as J² and J³. At the substation a bell 4 and a condenser 5 are included in a permanent bridge of the telephone-line, while a transmitter 6 and a receiver 7 are included in a second bridge that is normally open at the switch-hook 8. A cut-off relay R² is legged to ground from the sleeve side of the jack-section of the telephone-line and serves to render the line-signal inoperative when a connection is established with the line. The line conductor 3 is normally connected by a common lead 9, including the line-relay R, which controls the local circuit of the line-signal S with the live pole of a central common battery B. The operator's cord-circuits each includes an answering-plug P and a calling-

plug P², having tip and sleeve contacts adapted to register with the corresponding contacts of the jacks of the lines. The tip-contacts of said plugs are connected together by flexible strands *t* and *t*² and the interposed condenser *c*, while their sleeve-contacts are joined by the strands *s* and *s*² and the interposed condenser *c*². Supervisory relays *r* and *r*² are connected upon opposite sides of the battery B across the answering end of the cord-circuit and together control the local circuit of the supervisory signal S², while similar supervisory relays *r*³ and *r*⁴ are connected upon opposite sides of a similar common battery B² across the calling end of the cord-circuit, said relays controlling the local circuit of the supervisory signal S³, associated with the calling-plug of the cord-circuit. Tip-strand *t*² of the cord-circuit is normally open, and the forward portion thereof is connected by spring 10 of supervisory relay *r*⁴ with the conductor 11, leading to a normally open contact of the plug-seat switch in which the calling-plug P² normally rests. From this switch the conductor 12 extends to the high-resistance and high-impedance test-relay *r*⁵, whose opposite terminal is grounded. This relay controls, through its normally open contacts, a path for current from the battery B² over conductor 9^a and conductor 13, including the tertiary winding of the operator's induction-coil.

The operator's telephone set, including a receiver 17, the secondary of her induction-coil, and a condenser *c*³, is adapted to be bridged across the calling end of the cord-circuit by springs 18 of a suitable listening-key. A ringing-generator 19 is adapted to be connected with the forward portion of the strands *t*² of the cord-circuit by means of tip-ringing key-spring 20, while the forward portion of the sleeve-strand is simultaneously connected, through spring 20 of said key, with conductors 21 and 9^a, the former including a suitable resistance 22. The apparatus so far described is used for completing connections between subscribers terminating at the exchange C. I have shown another line L² of the same type as L, terminating at the branch office C², and a trunk-line L³, extending between said offices. This trunk-line is provided with jacks J⁴ J⁵ J⁶, &c., in any number at the office C and with a grounded retarda-

tion-coil 23 from the sleeve side of the trunk. This trunk-line extends in two limbs 24 and 25 to the office C², where the said limbs are connected together through the windings 26 and 27 of a repeating-coil W and a high-resistance trunk-relay *r*⁷. The other windings 28 and 29 of said repeating-coil, together with the condenser *c*⁴, serve to connect the tip and sleeve strands *t*³ and *s*³ of the trunk-cord, which at their opposite ends are connected, respectively, with the corresponding contacts of the trunk-plug P³, adapted to be inserted in any one of the jacks of the called telephone-lines. A short circuit of said high resistance trunk-relay *r*⁷, consisting of conductors 30 and 31, is controlled by normally open contacts of the tip-relay *r*⁸, legged to ground from the strand *t*³. A third relay *r*⁹ is associated with the trunk and is connected upon one side with the strand *s*³ by conductor 32, while upon the other side it is connected by conductors 33 and 34 with the live pole of the common battery B³. A disconnect-signal S⁴ and a ringing-signal S⁵ are provided for this end of the trunk-circuit and are suitably controlled by means of said relays, together with the locking-relay *r*¹⁰. The spring 35 of said relay *r*⁹ is connected with the forward portion of the strand *t*³ of the trunk-cord and normally engages with a contact connected with conductor 36, leading to a plug-seat switch in which the trunk-plug P³ normally rests. This switch is connected by conductor 37 with one pole of the high-resistance and high-impedance test-relay *r*¹¹, associated with the trunk-circuit. The operator's telephone 38 is connected, by means of an order-circuit 39, with the order-key 40 belonging to the operator at the exchange C.

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 the telephone-line and operating his signal S. Upon observing the signal the operator inserts the answering-plug P of her cord-circuit in one of the jacks of the line and connects her instrument therewith to receive the order of the subscriber. The insertion of the plug P closes a path for current from the battery B over the jack-section of the telephone-line to operate the cut-off relay R² and thence over the line conductors 2 and 3 of the telephone-line, thereby operating both supervisory relays *r* and *r*², the former serving to open the circuit of the supervisory signal S² to prevent its lighting. If the connection desired is with a subscriber whose line terminates at the same office, the line is tested, by means of the calling-plug P² of the cord-circuit, in the usual manner. The current will flow from the test-ring of the wanted line, if the line is busy, over the tip-strand *t*² of the cord-circuit, the tip-spring 10 of the relay *r*⁴, con-

ductor 11, plug-seat-switch contacts, since the plug is now out of the same and the said contacts are closed, and conductor 12 to and through the test-relay *r*⁵ to ground. This relay is therefore operated and causes a click in the operator's telephone. Said test-relay is separated from the cord-circuit and from all of the cord-circuits at the operator's position to which it belongs, and is therefore not affected by short circuits in any of said cord-circuits or by leakage upon some or all of them. If the line is found idle, the calling-plug P² is inserted in the telephone-line and the ringing-generator 19 operated in the usual way, the cut-off relay of the called line being maintained operated by current from the battery B² through conductors 21 and 9^a. Upon the insertion of the calling-plug P² the supervisory relay *r*⁴ is actuated to cut out the test-relay *r*⁵, whereby it is not again connected with the cord-circuit during the connection, and the operator's telephone may be connected at any time with the said cord-circuit without severing the cord-circuit strands or without connecting the test-relay therewith. Assuming that the subscriber wanted is located at the exchange C², the operator at exchange C² is informed over the order-circuit that connection is desired with the wanted line. This operator, who may be termed the "B" operator, informs the first or A operator what trunk to use for the connection. The A operator inserts the plug P² in the jack of that trunk-line, while the B operator inserts the plug P³ of the trunk into the jack of the wanted line after having properly tested the same to determine its idle or busy condition. The insertion of the plug P² into one of the jacks of the trunk completes a path for current through the retardation-coil 23 over the sleeve-strand *s*² of the cord-circuit and operates the supervisory relay *r*⁴, thereby permitting current to flow over the metallic telephone-line and through the high-resistance trunk-relay *r*⁷ at the incoming end of the trunk. This relay is of such high resistance that the tip supervisory relay *r*³ is unable to actuate, so that the supervisory signal S² is now lighted. In order to test the line L², the trunk-operator makes use of the plugs P³ in the usual manner, the test-relay *r*¹¹ being now connected with the strand *t*³ of said cord through contacts of the plug-seat switch. When the plug is in its seat, the said test-relay is isolated or disconnected from the trunk-cords. It will be understood that each such test-relay is common to the trunks for each operator. The insertion of the plug P³ closes the path for current from battery B³ over the sleeve-strand *s*³ of the cord-circuit, thereby actuating the cut-off relay R of the line L². The relay *r*⁹ is likewise operated and serves, by means of the spring 35, to disconnect the conductor 36 of the test-relay and to com-

plete the tip-strand t^3 for conversation. Its spring 41 also engages its front contact, and the path for current from the battery B^3 over conductors 34 42, spring 41, conductor 43, point 45, conductor 46, including ringing-lamp S^5 , and normal contacts of the locking-relay r^{10} is completed. This signal is therefore lighted to indicate that the subscriber has been called, but has not yet responded, the ringing-generator 47 being provided to call the subscriber in the same manner as has been described with reference to the cord-circuit and the cut-off relay being held up during ringing also in the same manner. Upon the response of the subscriber D a path for current is completed over the metallic telephone-line and the strand t^3 of the cord-circuit and thence through the relay r^8 , a spring of this relay serving to close the short circuit of high - resistance trunk - relay r^7 , whereby a sufficient flow of current is permitted over the trunk-line to actuate the supervisory relay r^3 in the cord-circuit at the central office C. The supervisory signal S^3 is thus extinguished to indicate the response of the called subscriber to the A operator. The operation of relay r^8 also causes its grounded spring 48 to engage its front contact, which is connected with conductor 49, leading to the point 45 and containing the winding of the locking-relay r^{10} . This relay is therefore connected with the live pole of the battery B^3 and is operated to open the circuit of the ringing-lamp S^5 and to also complete a locking-circuit for itself through conductor 50 and its front contacts. Thus the locking-relay prevents a second operation of the ringing-lamp during the connection or until the sleeve-relay r^9 is deenergized. At the termination of the conversation when the subscriber D returns his receiver to its hook the tip-relay r^8 is deenergized, thereby opening the short circuit about the relay r^7 , which is again thrown into the circuit of the outgoing end of the trunk and causes the tip supervisory relay r^3 to be deenergized and close its normal contacts, thereby lighting supervisory lamp S^3 . The supervisory lamp S^3 is lighted by the hanging up of the calling subscriber's telephone in the usual manner. The operator at the A office seeing both signals takes down the connection. By so doing the relay r^7 is again deprived of operating-current, so that its normal contacts are closed, and a path for current is now completed through disconnect-lamp S^4 , said path being traced from the live pole of the battery B^3 , over conductors 34 and 42, spring 41 of relay r^9 , conductor 43, point 45, conductor 51, containing lamp S^4 , the normal contacts of the trunk-relay r^7 , conductor 52, and the normal contacts of the relay r^8 . This lamp is therefore lighted to indicate to the B operator that the conversation has terminated and disconnection has been made at the out-

going end of the trunk. She therefore withdraws the trunk-plug P^3 and returns it to its seat. It will be observed that the lamp S^4 acts as a guard-signal in case connection is established with the wrong outgoing trunk, since the relay r^7 is alone actuated under such conditions, and completes a path for current through the lamp S^4 , including conductors 34 and 53, the front contacts of said relay r^7 , conductor 51, including the lamp, point 45, conductor 43, spring 41 of relay r^9 , its normal contact, and grounded conductor 54. Thus the operator at station C^2 is notified that an error has been made, and the A operator is notified. Under normal conditions therefore the test-relay associated with the trunk, as well as that associated with the cord-circuit, is disconnected and wholly isolated. This plug-seat arrangement is of special advantage in connection with the trunk-circuit, since the trunk-operators are not ordinarily provided with listening-keys.

Having described my invention, what I claim is—

1. In a telephone system, the combination with telephone-lines, of operator's connecting cords and plugs, a plug-seat switch for each plug, a supervisory relay associated with each cord, a testing-conductor common to the cords, said testing-conductor being connected with the cords through contacts of the associated plug-seat switch and disconnected therefrom through the contacts of said relay, substantially as described.

2. In a telephone system, the combination with telephone-lines, of a plurality of connecting-cords with connecting-plugs attached thereto and adapted to be used to establish connections with the lines for conversation, seat-switches for said plugs, a supervisory relay for each cord, testing-circuits for said cords completed over a strand of each and a common conductor, the individual portions of said circuits including the contacts of the associated plug-seat and supervisory relays, substantially as described.

3. In a telephone system, the combination with telephone-lines, of a plurality of connecting cords and plugs to establish connections with the lines for conversation, plug-seat switches for said plugs, a testing device common to said cords, the testing-circuits of said cords comprising a strand of each and said common testing device, a supervisory relay for each cord, and means for connecting said device with the respective cords through the medium of the associated supervisory relay and plug-seat switch, substantially as described.

4. In a telephone system, the combination with a plurality of telephone-lines, of a plurality of connecting cords and plugs to establish connections with the lines for conversation, supervisory relays for said cords a central common source of current associ-

ated with said cords and adapted to be included in the telephone-lines to furnish current for conversation, a test-relay for the cords, plug-seat switches for said plugs, and means for connecting said test-relay with the cords through the medium of said plug-seat switches and for disconnecting said relay therefrom through said supervisory relays when a connection is established with the line for conversation, substantially as described.

5. In a telephone system the combination with telephone-lines, of a plurality of connecting cords and plugs to establish connections with the lines for conversation, seat-switches for said plugs, supervisory relays for said cords, a testing device common to said cords, testing-circuits including a strand of each cord and the said common device, said device being connected with the cord through the medium of contacts of said relays and plug-seat switches, the plug-seat switches serving normally to disconnect said

test device and the relay serving to disconnect the same during conversation, substantially as described.

6. In a telephone testing system, the combination with telephone-lines, of a plurality of cord-circuits to establish connections with the lines for conversation, a common source of current associated with the cord-circuit and adapted to be included in the telephone-lines for conversation, a high-impedance and high-resistance test-relay common to a plurality of said cord-circuits, and means for connecting said relay with the cord-circuits for testing purposes by the removal of the plug from its normal position, 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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