

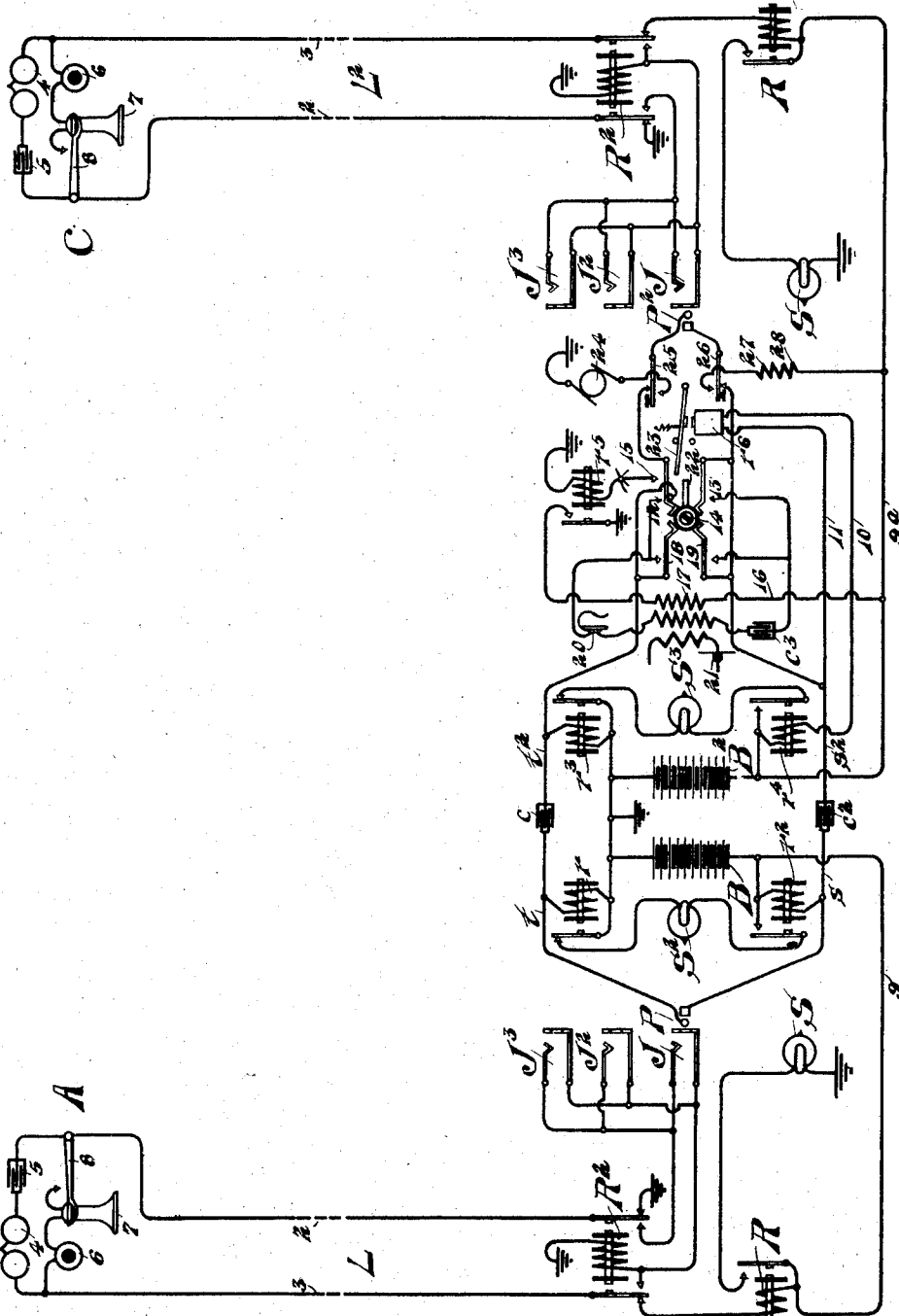
No. 864,454.

PATENTED AUG. 27, 1907.

W. W. DEAN.

TESTING SYSTEM FOR TELEPHONE LINES.

APPLICATION FILED JUNE 29, 1903.



Witnessed.

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UNITED STATES PATENT OFFICE.

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TESTING SYSTEM FOR TELEPHONE-LINES.

No. 864,454.

Specification of Letters Patent.

Patented Aug. 27, 1907.

Application filed June 29, 1903. Serial No. 163,612.

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 testing systems for telephone lines.

10 In my Reissue Patent No. 12,090, March 3rd, 1903, I have shown a testing system in which the subscribers' lines are provided with testing contacts connected with the talking circuits of the lines and in which a test relay is normally connected with the testing strands of the cord circuits at each operator's position. In this arrangement, if one of the cord circuits in the operator's position becomes short circuited, or if there is a general leakage in all the cords at some particular operator's position, the test relay of that position becomes actuated, and the whole position where this occurs is thus thrown out of use until suitable repairs or overhauling have been undergone.

My present invention contemplates the use of a test relay, or equivalent arrangement as before, that is likewise preferably common to the cord circuits at each operator's position but which is normally isolated or disconnected from the testing conductors of each cord circuit. I then provide suitable means for connecting said relay or equivalent device with the testing conductor of a cord circuit when it is desired to test the condition of the wanted line.

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

35 In said figure, L and L² indicate subscribers' lines, extending in two limbs 2 and 3 from their respective substations A and B to the central office. At each substation a signaling bell 4 and a condenser 5 are included in a permanent bridge of the line conductors, while a transmitter 6 and a receiver 7 are placed in a bridge whose normal discontinuity is maintained by the switch-hook 8.

At the central office the line is fitted as is usual with a signal S, preferably in the form of a small incandescent lamp, an answering jack J and multiple jacks J² and J³ in any number. The line conductor 2 is normally grounded but is adapted to be connected with the tip side of the jack section of the line during conversation, while the sleeve conductor 3, which is adapted to be connected during conversation with the sleeve side of the jack section of the line, is normally connected with the conductor 9 or 9^a leading to the live pole of the common battery B or B², said conductor including the winding of the line relay R which controls the local circuit of the line signal S. The

cut-off relay R², which serves to change the line conductors from their normal connections to their alternate connections, has its winding legged to ground from the sleeve side of the jack section of the telephone line.

Each operator is provided with a plurality of cord circuits one only being fully shown in the drawing, in which is provided an answering plug P and a calling plug P², 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 said plugs are joined by flexible strands *t* and *t*² and the interposed condenser *c*, while their sleeve contacts are similarly united by strands *s* and *s*² and the interposed condenser *c*². The supervisory relays *r* and *r*² are bridged across the answering end of the cord circuit upon either side of the battery B, and serve to control the local circuit of the supervisory signal S² and a similar pair of supervisory relays *r*³ and *r*⁴ are connected across the calling end of the cord circuit upon either side of the battery B² and control the local circuit of the supervisory signal S³ associated with the corresponding plug. In circuit with the supervisory relay *r*⁴ between the live pole of the battery B² and the strand *s*² of the cord circuit is placed another magnet *r*⁶, the function of which will be later explained, conductor 10 extending between said relay *r*⁴ and one terminal of the magnet *r*⁶, while conductor 11 leads from the other terminal of said magnet *r*⁶ to the strand *s*² of the cord circuit.

For the purpose of testing the idle or busy condition of the lines, I provide a test relay *r*⁵, preferably of high resistance and high impedance, and which is also preferably common to all of the cord circuits at each operator's position and is normally disconnected or isolated from said cord circuits. In order to suitably connect this relay with the testing strand of the cord circuit, I provide additional springs 12 and 13 for the listening key, the tip strand *t*² of the cord circuit being carried through the normal contact of said spring 12. When the lower end of the lever 14 of the listening key is moved toward the right, said spring 12 opens the strand *t*² of the cord circuit and engages the contact 15 to thereby connect the test relay *r*⁵ with its forward portion and the tip of the calling plug P². The test relay controls through its normally open contacts a path for current from the live pole of the battery B², over conductors 9^a and 16, including the tertiary winding 17 of the operator's induction coil. The springs 18 and 19 of the operator's listening key serve when the lever 14 thereof is moved in the opposite direction toward the left to connect the operator's head telephone 20, the secondary winding of her induction coil and the condenser *c*³ in a bridge of the calling end of the cord circuit. It will also be noted that said bridge is com-

pleted by springs 12 and 13 when the lever 14 is moved to the right. The transmitter 21 and the primary winding of her induction coil are charged from any suitable source of current. It is thus seen that, by moving the lever of the listening key toward the right the test relay is connected with the cord circuit for testing, and that upon moving it in the opposite direction said test relay is disconnected and the operator's head telephone is connected with the said cord circuit.

This listening key may be of any desired type, but is preferably one in which horizontal springs are located beneath the top plate and in which the operating lever 14 is pivoted to said top plate in the usual manner with the operating handle projecting above the same and the spring operating portion below said plate and between the ends of the springs.

In order to prevent severing the testing strand during connections and to prevent again connecting the test relay therewith, I provide a stop 22 upon the side of said lever 14 toward the springs 12 and 13, and arrange the armature 23 of the relay r^6 in such a manner that when the magnet is energized said armature 23 is moved in front of said stop 22 and prevents the lever 14 from being moved in that direction during the time that the magnet is energized. Inasmuch as said magnet is in the path of current to the sleeve strand s^2 of the cord circuit, it is obviously energized as soon as a connection is established with the called line so that thereafter it is impossible to move the listening key in such manner as to open the cord circuit or to connect the test relay therewith. This magnet is preferably small and is arranged in any suitable manner, preferably by securing the same to the frame of the listening key, the armature 23 being likewise supported from said frame, all in a manner well understood by those skilled in the art.

A ringing generator 24 is adapted to be connected with the cord circuit by the operation of the spring 25 of the ringing key, while the spring 26 of said key, which is simultaneously operated, serves to connect with the battery lead 9^a by means of conductor 27 containing a suitable resistance 28.

In the operation of my system, the subscriber A, for example, takes up his receiver, and thereby completes a path for current from battery B over the telephone line L, and through the line relay R, which is operated to close the local circuit of the line signal S. Upon observing this signal the operator inserts the answering plug P in the answering jack J of the calling telephone line, thereby completing a path for current over the sleeve conductor of the jack section of the line to operate the cut-off relay R^2 . This relay serves when operated to render the line signal of the calling line inoperative and to place the line in condition for conversation. Current from the battery B now circulates over the metallic telephone line to the substation A thereby operating both supervisory relays r and r^2 , which prevents the lighting of the supervisory signal S^2 . Moving the lever 14 of her listening key to the left, the operator connects her head telephone with the telephone line and receives the order for the connection. She then moves the lever in the opposite direction to connect the test relay r^5 with the strand t^2 of the cord circuit and proceeds to test the condition of the wanted line. If the line is idle the test rings are grounded and

since the tip of the testing plug is likewise grounded through the test relay r^5 they are at the same potential and no flow of current takes place and no click is received by the operator. Should the line be connected for conversation, however, the test rings are connected with the live pole of either battery B or B^2 and when the grounded tip of the testing plug is brought into contact therewith a flow of current takes place through said test relay, the path for current over the strand t^2 beyond the test relay being open at the spring 12 of the listening key. This flow of current is sufficient to operate the test relay r^5 , which closes the path for current from battery B^2 through the tertiary winding of the operator's induction coil, and a click is therefore inductively caused in the operator's receiver, sufficient capacity for this being provided by the condenser and other apparatus connected with the operator's bridge. This test relay is of sufficient resistance and impedance to prevent large or sudden variation of current upon the connected lines so that the talking subscribers are not disturbed thereby.

Assuming that the line is found idle the listening key lever is moved to its central position and the calling plug P^2 inserted in one of the multiple jacks in the line. The insertion of this plug completes a path for current through the supervisory relay r^4 , the magnet r^6 and the cut-off relay R^2 of the wanted line. The relay r^6 therefore attracts its armature which engages the stop 22 carried upon the lever 14 of the listening key and prevents its operation in that direction again during the connection. Relay r^4 is also now operated to close the local circuit of the supervisory signal S^3 , which is lighted to indicate that the subscriber has not yet responded. The cut-off relay R^2 of the line L^2 is likewise operated to prevent the line signal of said line from being actuated. As soon as the plug P^2 was inserted the operator depressed the springs 25 and 26 of the ringing key with the result that the ringing generator 24 was connected with the telephone line L^2 to operate the bell at the substation while the cut-off relay R^2 was maintained actuated during ringing by the current over conductors 9^a and 27. Upon the response of the called subscriber the tip supervisory relay r^3 is actuated to open the local circuit of the supervisory signal S^3 which extinguishes the signal to indicate to the operator the fact of the response of the called subscriber.

During conversation the batteries B and B^2 are sending current out over the telephone lines to charge the substation transmitters and for the operation of the various relays and magnets associated with the telephone lines. The operator's set may be connected with the cord circuit by the movement of the listening key lever 14 to the left without hindrance from the magnet r^6 and without opening the cord circuit strands. Thus communication may be had by the operator with either subscriber without taking down the connection. At the termination of the conversation, the return of the subscribers' receivers to their hooks opens the line circuits and deenergizes supervisory relays r and r^3 . Supervisory lamps S^2 and S^3 are therefore lighted to indicate to the operator the termination of the conversation. Upon observing these signals she takes down the connection and returns all parts to normal condition.

The several grounds mentioned may be one and the same, or the common office return, the ringing key is

preferably one in which the springs are simultaneously operated by suitable mechanism; and various changes and alterations may be made in the invention without departing from the spirit or scope thereof.

5. What I claim is:—

1. In a telephone testing system, the combination with a plurality of cord circuits having testing terminals, of a listening key associated with each cord circuit and adapted to connect the operator's telephone therewith, a test relay common to said cord circuits and normally disconnected therefrom, means for connecting said relay with each cord circuit by means of the corresponding listening key for testing purposes, and means to prevent again connecting said relay with the cord circuit during the connection, substantially as described.

2. In a telephone testing system, the combination with a plurality of cord circuits, of a test relay common to said circuits but normally disconnected therefrom, a test responsive device associated with the operator's telephone set and controlled by said relay, and a switch to connect said relay with any of said circuits when it is desired to use the same for making the busy test, a testing circuit, and means to exclude said testing circuit from a cord circuit during conversation, said means including a relay and a portion of the connected cord circuit, substantially as described.

3. In a telephone system, the combination with a telephone line, of a plurality of cord circuits adapted to be connected with said line, a listening key for each cord circuit, an operator's telephone adapted to be connected by said keys to the said cord circuits, a test relay common to said cord circuits but normally disconnected therefrom, a test responsive device controlled by said relay, a test contact for the line normally disconnected therefrom, and means for connecting said relay with each cord circuit by means of the corresponding listening key and with the test contact of the line by means of the cord circuit, and means for receiving a test only when said test contact is connected with a line, substantially as described.

4. In a telephone system, the combination with a plurality of cord circuits, of a listening key associated with each cord circuit and adapted to connect the operator's telephone therewith, a test relay common to said cord circuits but normally isolated therefrom, a test responsive device associated with said telephone and controlled by said relay, means for connecting said relay with each cord circuit through the medium of the corresponding listening key and for disconnecting the same during conversation, and means for connecting the telephone with the cord circuit after the connection is established and whereby said test relay cannot be again connected during conversation.

5. In a telephone system, the combination with subscribers' lines, of testing terminals connected with the talking circuit of said lines, a plurality of operator's connecting cords, an operator's telephone adapted to be connected with said cords, a testing circuit having a portion common to said cords a test relay in said portion over which together with a portion of the corresponding cord circuit the busy testing circuits are completed, and means for normally isolating said common portion of the busy testing circuits from said cords and from the operator's telephone and for preventing the same from being again connected during the connection of the cord with a called line, substantially as described.

6. In a telephone system, the combination with subscribers' lines, of testing terminals therefor connected with one side of the talking circuit, a plurality of operator's connecting cords, a testing circuit having a portion common to said cords a test relay in said portion, the said testing circuits being completed over a portion of each cord circuit, said circuits being of high resistance, and means for normally isolating said common portion from said cords and from the operator's set, and for preventing the same from being again connected during the connection of the cord with a called line, substantially as described.

7. In a telephone system, the combination with a cord circuit for establishing connections, of a test relay nor-

mally disconnected from said circuit, means for connecting said relay with said circuit an operator's telephone, and means to connect said telephone with the said circuit after the connection has been established and for preventing the connection of said test relay therewith during said connection, substantially as described.

8. In a telephone system, the combination with a plurality of cord circuits, of a testing circuit for said circuits, a key associated with each of said cord circuits and adapted by its actuation to connect said testing circuit with the associated cord circuit, an electro-magnet associated with said key adapted to be actuated when a connection is established with a telephone line to prevent the actuation of said key, substantially as described.

9. In a telephone system, the combination with a cord circuit for establishing connections, of a test relay normally disconnected from the circuit, means for connecting said relay with said circuit an operator's telephone, and means to permit connecting said telephone with said circuit after the connection has been completed and to prevent again connecting said relay thereto or opening the testing strand, substantially as described.

10. In a telephone testing system, the combination with a plurality of cord circuits, of a listening key associated with said cord circuits and adapted to connect the operator's telephone therewith, a test relay common to said cord circuits and normally disconnected therefrom, means for connecting said relay with each cord circuit by means of the corresponding listening key for testing purposes, and electrically-operated means to prevent again connecting said relay with the cord circuit during the connection, substantially as described.

11. In a telephone testing system, the combination with a plurality of cord circuits, of a listening key associated with said cord circuit and adapted to connect the operator's telephone therewith, a test relay common to said cord circuits and normally disconnected therefrom, means for connecting said relay with each cord circuit by means of the corresponding listening key for testing purposes, a relay actuated when a connection is made for conversation, and means controlled by said relay for locking said listening key whereby said test relay cannot be connected with the cord circuit during conversation, substantially as described.

12. In a telephone system, the combination with a plurality of cord circuits, of a test circuit for said plurality of cord circuits, a key associated with each of said cord circuits adapted to connect its respective cord circuit with said testing circuit, a supervisory relay associated with the cord circuit and adapted to be actuated when a connection is established with a telephone line, and a relay associated with said key and connected in series with said supervisory relay and adapted to be actuated simultaneously therewith to prevent the actuation of said key, substantially as described.

13. In a telephone system, the combination with a plurality of cord circuits, a testing device normally isolated therefrom, means for connecting said device with a cord circuit for testing, means for preventing the connection of said device with said cord circuit during the connection of said cord circuit with a called line, and means permitting the operator to communicate with the connected subscribers at any time, substantially as described.

14. In a telephone system, the combination with a plurality of cord circuits, a testing device normally isolated therefrom, means for connecting said device with a cord circuit for testing, means for preventing said device from being again connected with the cord circuit during conversation, and means for permitting the operator to communicate with the connected subscribers at any time, substantially as described.

15. In a telephone system, the combination with a plurality of cord circuits, a testing relay normally isolated from said circuits, means associated with the listening key for connecting said relay with a cord circuit, and means actuated by current over one of the talking strands of the cord circuit for preventing the connection of said testing relay after a connection has been established with the called telephone line, substantially as described.

16. In a telephone system, the combination with a plu-

5 rality of cord circuits, a testing device for said circuits normally isolated therefrom by contacts of the listening key, and magnetic means actuated over a portion of the talking circuit, and a third conductor when a connection is established with the called line for preventing said testing device from being again connected with the cord circuit, substantially as described.

10 17. In a telephone system, the combination with a cord circuit, of a normally isolated testing device, means for connecting said device with a cord circuit for testing, and means for thereafter positively maintaining the isolation

of said device from the cord circuit during the connection, without preventing the operator from listening to communications on the connected lines, substantially as described.

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

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,
EVA A. GARLOCK.