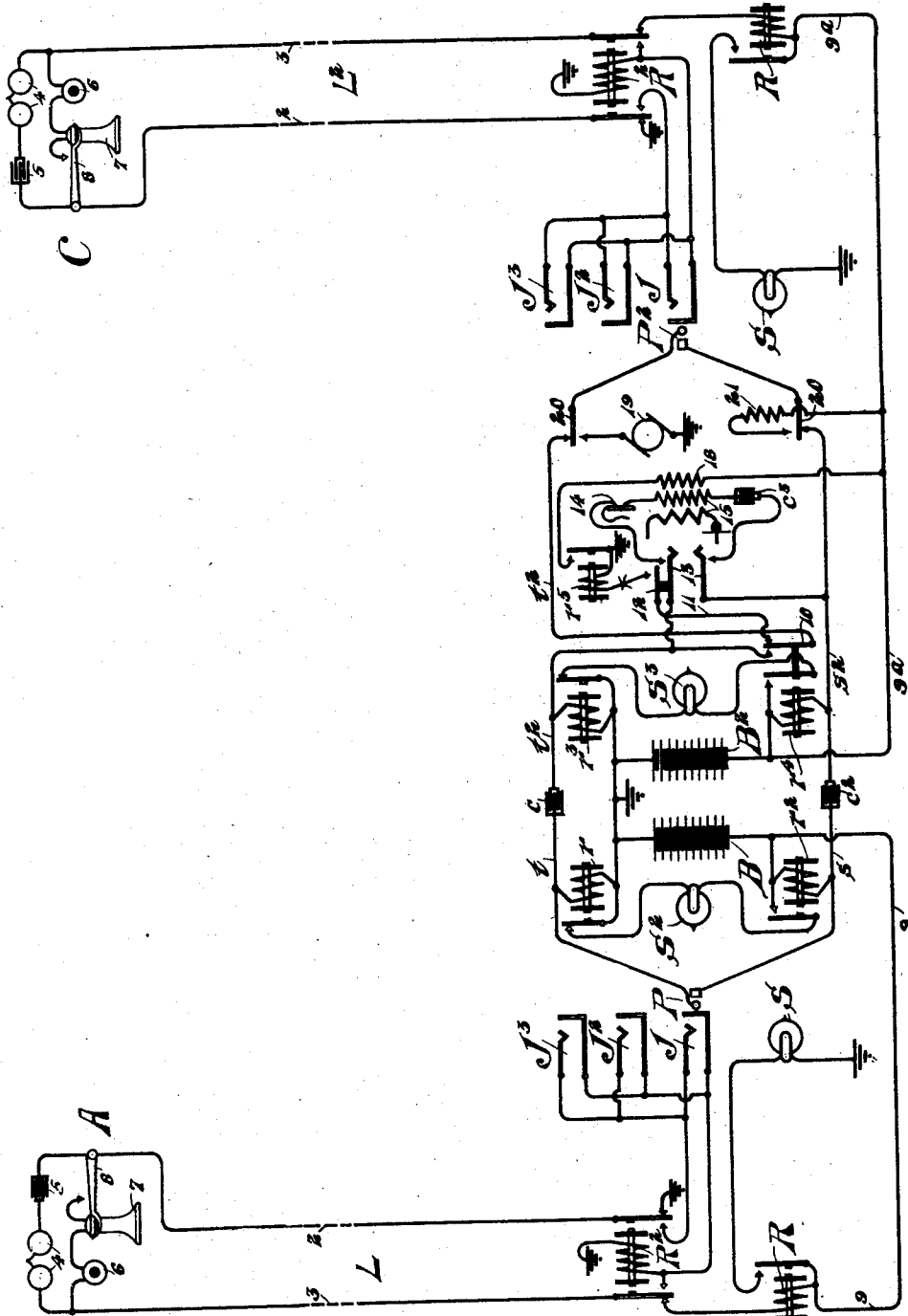


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 TESTING SYSTEM FOR TELEPHONE LINES.
 APPLICATION FILED JUNE 29, 1903.

Patented Dec. 8, 1908.

905,854.



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UNITED STATES PATENT OFFICE.

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TESTING SYSTEM FOR TELEPHONE-LINES.

No. 905,854.

Specification of Letters Patent.

Patented Dec. 8, 1908.

Application filed June 29, 1903. Serial No. 163,613.

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 telephone testing systems.

In my Reissue Patent No. 12,090, March 3rd, 1903, I have shown and described a testing system in which a test relay is normally connected with the testing strands of all the cord circuits at each operator's position. In my Patent No. 864,454 granted August 27th, 1907, I show and describe means for normally isolating the said relay to prevent deranging the whole operator's position when one or more cord circuits are short circuited or when by reason of general leakage or other causes, a normal flow of current through the said relay if connected therewith would be made possible.

My present invention relates to the same general subject matter as the application above mentioned, but consists in means whereby the connection of said normally isolated relay with a cord circuit for testing the condition of a wanted line is automatically accomplished in the operation of other parts. This connection I preferably achieve automatically in the use of the listening key, and I further provide means whereby when the connection is once established the operator's set may be again connected with the cord circuit without severing the cord circuit. Other features and advantages will appear from the detailed description and claims.

The invention is shown in the accompanying drawing, in which the figure is a diagram of a system embodying my invention.

In this figure L and L² 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 included 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, an answering jack J, and a plurality of multiple jacks J² and J³. The line conductor 2 is normally grounded

but is adapted during conversation 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^a extending to the live pole of the battery B or B² and including the winding of the line relay R which controls the local circuit of the line signal S. The cut-off relay R² has its winding connected to ground from the sleeve conductor of the jack section of the line.

The operator's cord circuit comprises an answering plug P and a calling plug P² having tip and sleeve contacts adapted to register with the corresponding contacts of the spring jacks of the lines when inserted therein, the tip contacts of the said plugs being connected together by the 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. The supervisory relays *r* and *r*² are connected upon each side of the battery B in a bridge of the answering end of the cord circuit, and together control the local circuit of the supervisory signal S², while the supervisory relays *r*³ and *r*⁴, together with the battery B² are included in a bridge of the calling end of the cord circuit, and similarly control supervisory signal S³. The tip strand *t*² of the cord circuit is normally open at the forward contact of spring 10 of sleeve supervisory relay *r*⁴ and the forward portion thereof is normally connected with a branch conductor 11 leading to an extra spring 12 upon the operator's listening key. The springs 13 of this listening key are adapted when operated to connect the operator's receiver 14, the secondary of her induction coil 15 and the condenser *c*³ in a bridge of the calling end of the cord circuit. When said springs are operated the auxiliary spring 12 is connected with the high resistance and high impedance test relay *r*⁵, preferably common to all cord circuits of each operator's position, the other terminal of which is grounded. Thus under normal conditions the test relay is disconnected from the cord circuit, and in fact from all cord circuits; but when the listening key is operated to connect the operator's telephone with the circuit in order to receive the call of the calling subscriber and to test the condition of the wanted line, said test relay is automatically connected with the forward portion of the tip calling strand of the cord circuit. It is thus

seen that if a general leakage exists at the operator's position, or if one of the cord circuits becomes short circuited by any means, the test relay is not operated thereby, and the cord circuits that are not so disabled may be used in the ordinary manner for testing. The front contact of said test relay r^5 is connected by the branch conductor 16 including the tertiary winding 18 of the operator's induction coil, with the battery lead 9^a leading to the live pole of the battery B^2 . Current thus flows from battery B^2 through said winding 18 of the induction coil and over the contacts of said relay r^5 to ground when the latter is energized.

A suitable ringing generator 19 is adapted to be connected with the tip strand of the cord circuit when the ringing key springs 20 are operated, the sleeve conductor at the same time being connected through resistance 21 with the said battery lead 9^a to hold up the cut-off relay during ringing.

A subscriber calls the central office in the usual manner, by taking up his receiver and completing the circuit from the battery B over his line, thereby operating the line relay R to close the local circuit of the signal S. Upon observing the signal the operator connects her head telephone with the cord circuit, and after learning the number of the wanted party's line, proceeds to test that line. If the line is busy the testing 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 tip strand t^2 , conductor 11, the spring 12 of the listening key, and thence over the test relay r^5 to ground. This test relay is of such high resistance and impedance as to prevent a sudden or large variation of current upon the line so that the parties in conversation are not annoyed. As soon as the test relay r^5 operates the circuit through the conductor 16 and the tertiary winding 18 of the operator's induction coil is completed, and a click is caused in the operator's receiver.

If the line is idle the test rings of the line are connected with ground, and since the test relay is also connected with ground no flow of current results and no click is received. Static charges upon the line, which are comparatively weak, pass off through the test relay without operating it and hence without affecting the operator's instrument so that no false busy tests are given by such charges.

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 operated to connect the calling generator in circuit with the wanted line to call the subscriber. After the subscriber has been called but before his response the sleeve supervisory relay r^4 is operated to disconnect the branch conductor 11 and complete the tip strand for conversation. During conversation the su-

pervisory signals are inert and the batteries B and B^2 are sending current out over the telephone lines to charge the substation transmitters. At the termination of the conversation the return of the subscribers' receivers to their hooks deenergizes the tip supervisory relays r and r^3 and the supervisory signals S^2 and S^3 are lighted to indicate at central the fact of the termination of the conversation.

Should it become necessary to connect the operator's telephone with the cord circuit during the connection, this may be done without again connecting the test relay with the tip strand of the calling plug, and also without severing the said strand t^2 . Connection by the operator with the called subscriber is thus permitted.

Having described my invention, what I claim is:

1. In a telephone testing system, the combination with a plurality of cord circuits, a testing device common to said circuits, the circuit of said device being independent of the circuit of the operator's listening set, supervisory signal controlling magnets for the cord circuits, listening keys for said cord circuits to connect the operator's telephone therewith, the connection of said testing device with said cord circuits being controlled through the medium of said magnets and said keys, substantially as described.

2. In a telephone testing system, the combination with a plurality of cord circuits, of a testing device common to said circuits, the circuit of said device being independent of the circuit of the operator's listening set, a listening key and a supervisory relay for each circuit, the connection of said testing device with each cord circuit being controlled through contacts of the listening key and supervisory relay associated therewith, substantially as described.

3. In a telephone testing system, the combination with a plurality of cord circuits, of a high resistance testing device common to said circuits, the circuit of said device being independent of the circuit of the operator's listening set, a listening key and a supervisory relay for each circuit, the connection of said high resistance testing device with each cord circuit being controlled through contacts of the listening key and supervisory relay associated therewith, substantially as described.

4. In a telephone testing system, the combination with a plurality of cord circuits, of a high resistance and impedance testing device common to said circuits, the circuit of said device being independent of the circuit of the operator's listening set, a listening key and a supervisory relay for each circuit, the connection of said high resistance and impedance testing device with each cord circuit being controlled through contacts of the listen-

ing key and supervisory relay associated therewith, substantially as described.

5 5. In a telephone testing system, the combination with a plurality of cord circuits, of a test relay common to said circuits, the circuit of said relay being independent of the circuit of the operator's listening set, a test responsive device controlled by said relay, a listening key and a supervisory relay for each
10 cord circuit, the connection of said relay with each cord circuit being controlled through contacts of a corresponding listening key and supervisory relay, substantially as described.

15 6. In a telephone testing system, the combination with a plurality of cord circuits, of a test relay common to said circuits, the circuit of said relay being independent of the circuit of the operator's listening set, a test responsive device in connection with the operator's telephone controlled by said relay, a
20 supervisory relay and a listening key associated with each cord circuit, the connection of said relay with each cord circuit being controlled through contacts of the listening key
25 and the supervisory relay, substantially as described.

30 7. In a telephone testing system, the combination with a plurality of cord circuits, the busy testing circuit of said circuits having a common portion, a supervisory relay and a listening key for each of the cord circuits, the common portion of said circuit being suitably controlled through contacts of said
35 supervisory relay and listening key and being independent of the circuit of the operator's listening set, substantially as described.

40 8. In a telephone testing system, the combination with a plurality of cord circuits, the busy testing circuit of said circuits having a common portion, a supervisory relay and a listening key for each of the cord circuits, said listening key serving to connect said
45 common portion with the corresponding cord circuit and the associated supervisory relay serving to disconnect said portion, substantially as described.

50 9. In a telephone testing system, the combination with a plurality of cord circuits, of a test responsive device common to said circuits but normally disconnected therefrom, a listening key and a supervisory relay for each
55 cord circuit, the listening keys serving when operated to connect the said device with the corresponding cord circuits and the associated supervisory relay serving when energized to disconnect said device, substantially as described.

60 10. In a telephone testing system, the combination with a plurality of cord circuits, of a normally disconnected test relay common to said circuits, a test indicating device controlled by said relay, a listening key for each cord circuit, an operator's telephone adapted to be connected with the cord
65 circuits by the said keys, and means for automati-

cally connecting the test relay with one end only of the cord circuits upon the operation of the listening keys to connect the telephones therewith, substantially as described.

11. In a telephone testing system, the combination with a plurality of cord circuits, of a test relay common to said circuits, a listening key for each cord circuit, and means for automatically connecting said test relay with the calling end of the cord circuit
75 in the actuation of said listening key and for again disconnecting said relay when a connection is established with the tested line, substantially as described.

12. The combination with telephone lines having testing terminals conductively connected to the substation on one side of the talking circuit when the lines are in use, of a cord circuit and a central source of current to furnish current for talking purposes associated with the lines, testing apparatus comprising a testing contact to cooperate with one of said terminals in testing, a high resistance test relay normally disconnected from said test contact, and means for connecting said test relay with said test contact,
90 substantially as described.

13. The combination with telephone lines having testing contacts conductively connected to the substation on one side of the talking circuit when the lines are connected for conversational purposes, of a cord circuit and a central source of current to furnish current for talking purposes associated with the lines, testing apparatus comprising a test contact to cooperate with one of said terminals in testing, a high resistance test relay normally disconnected from said testing contact, an operator's listening key, and automatic means whereby the actuation of said listening key serves to connect said test relay in circuit with said test contact, substantially as described.

14. In a telephone exchange system, the combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble conductively connected to the substation over one of said line limbs, cord connecting apparatus for connecting said line with another for conversation, an operator's telephone set, switching mechanism for connecting said telephone set with said cord connecting apparatus, a test contact associated with said cord connecting apparatus, a test relay in a circuit of high resistance and high impedance normally disconnected from said contact, a signaling device controlled by said test relay, and means whereby the actuation of said switching mechanism may serve to connect said test relay in circuit with said test contact, substantially as described.

15. In a telephone exchange system, the combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay in a circuit of high resistance and high impedance normally disconnected from said test contact, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and means whereby the insertion of said calling plug within a line jack causes the closure of the break in the continuity of the tip cord strand, substantially as described.

16. In a telephone exchange system, the combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs said tip strand being normally discontinuous, a test relay in a circuit of high resistance and high impedance normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, switching means for connecting said test relay with the tip contact of said calling plug and means whereby the insertion of said calling plug within a line jack causes the closure of the break in the continuity of the tip cord strand, substantially as described.

17. In a telephone exchange system, the

combination with a telephone line extending by its limbs from a substation to an exchange, of a source of current at the exchange for supplying talking and signaling current to said line, a plurality of line jacks at the exchange each having a test thimble connected to one of said line limbs, an answering plug, a calling plug, tip and sleeve strands connecting tip and sleeve contacts of said plugs, said tip strand being normally discontinuous, an operator's telephone set, a listening key for connecting said telephone set with said cord strands, a test relay normally disconnected from the tip contact of said calling plug, a signaling device controlled by said test relay, means whereby the manipulation of said listening key serves to connect said test relay with the tip contact of said calling plug, and a supervisory controlling relay controlling the break in the continuity of the tip cord strand, said relay being primarily controlled by the insertion of the calling plug within a line jack to close the break in the continuity of the tip cord strand, substantially as described.

18. The combination with telephone lines having testing terminals conductively connected with the substation over one side of the talking circuit when the lines are connected for conversational purposes, of a cord circuit and a central source of current for furnishing current for talking purposes, testing apparatus comprising a test contact to cooperate with one of said terminals in testing, a high resistance testing circuit normally disconnected from said test contact, an operator's listening key, and automatic means whereby the actuation of said listening key serves to include said test contact in said test circuit, 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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