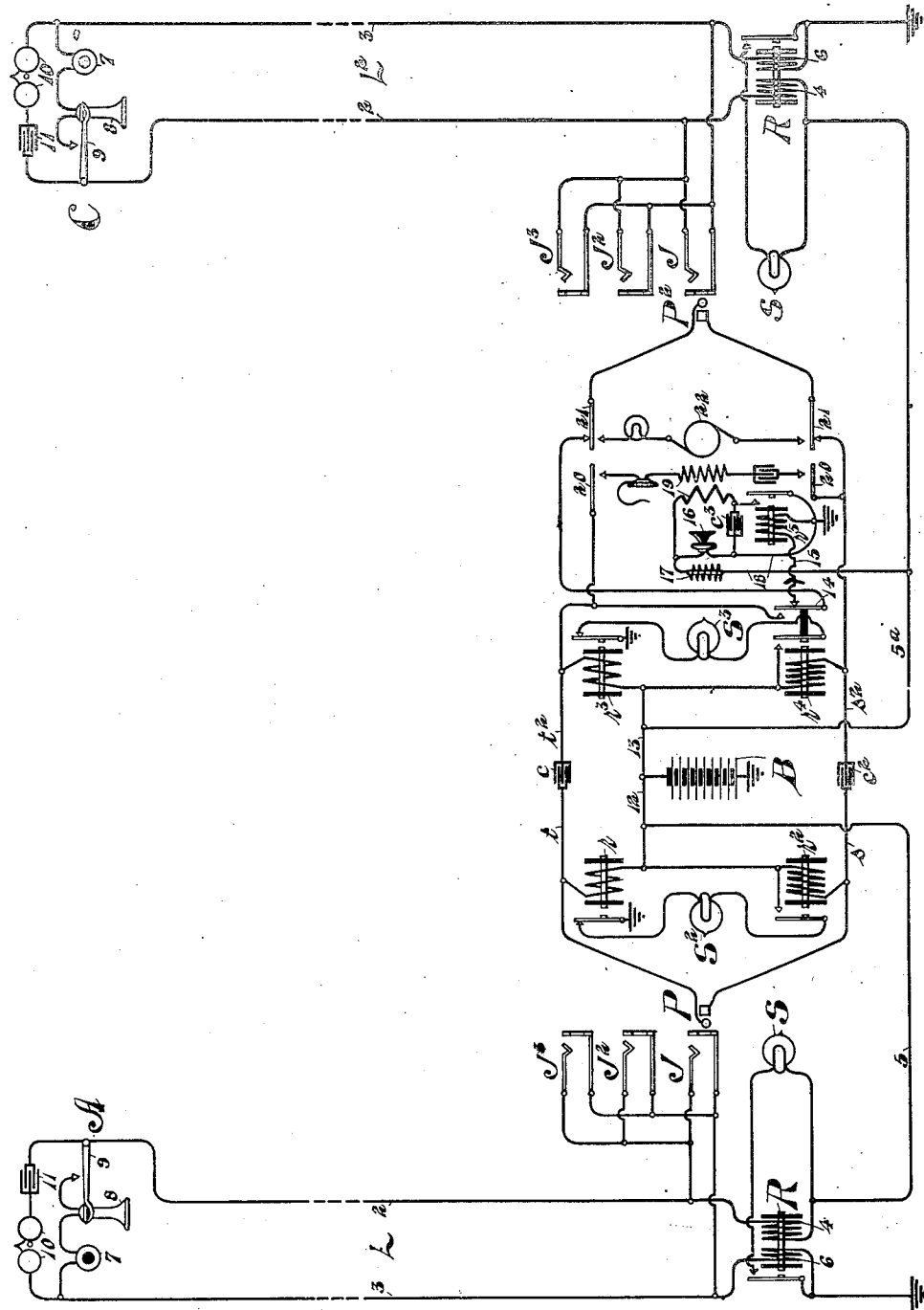


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W. W. DEAN.
TELEPHONE SYSTEM.
APPLICATION FILED DEC. 23, 1902.



Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 832,121.

Specification of Letters Patent.

Patented Oct. 2, 1906.

Application filed December 23, 1902. Serial No. 136,332.

To all whom it may concern:

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

My invention relates to improvements in telephone systems whereby the lines which are of the common-battery multiple-switch-board type are provided with only a single relay or electromagnetic signaling device. The apparatus for a telephone-line usually requires a line-relay to operate the line-signal and a cut-off relay actuated during a connection for conversation to render said relay or signal inoperative. In my invention I provide a single device which is capable of performing all the functions of the two devices of the ordinary line.

My invention is shown in the accompanying drawing, which represents diagrammatically a telephone system embodying my improvements and in which the same reference characters are used throughout to designate similar parts.

The subscribers' lines L and L^2 extend from their respective substations A and C to the central office, where they are fitted with the usual spring-jacks or connection-terminals, such as J , J^2 , and J^3 , in any desired number and with a line-signal S , which is preferably in the form of a small incandescent lamp having its circuit controlled through the normally open contacts of the relay R . The line conductor 2 includes a high-resistance winding 4 of the relay R and is then connected by conductor 5 with the live pole of a battery B , preferably common to the exchange or to a large number of lines thereof. A line conductor 3 includes the helix 6 of low resistance of said relay R and is thence connected to ground or the common office return. These windings or helices 4 and 6 are differentially disposed on the core of the magnet with reference to steady currents in the metallic line and are preferably wound end on to prevent the passage therethrough of the voice-currents. At the substation of the line any suitable common-battery outfit may be employed and which is diagrammatically indicated in the drawing.

This special apparatus includes a transmitter 7 and receiver 8 in a bridge of the line-conductors, which is normally open at the switch-hook 9, while an ordinary call-bell 10 and condenser 11 are connected, preferably, in a permanent bridge of the line conductors. Both lines, and, in fact, all lines of the exchange, are of the same type, and hence the description of one suffices for all.

The operator's cord circuit, of which there may be as many as desired, comprises a pair of plugs P and P^2 , each having tip and sleeve contacts adapted to register with the like contact-surfaces of the spring-jacks or connection-terminals of the lines and the tip-contacts of which plugs are joined together by the strands t and t^2 and the interposed condenser c , while the sleeve-contacts thereof are inductively joined by the similar flexible strands s and s^2 and the condenser c^2 . At the answering end of the cord-circuit a pair of supervisory relays r and r^2 are bridged across, and an intermediate point of the bridge is joined by a suitable conductor, such as 12, with the live pole of said battery B . The tip-relay is preferably of one hundred ohms resistance and the sleeve-relay of about five hundred ohms. These relays control the circuit of the supervisory lamp S^2 , which is normally closed at the contacts of relay r and normally opened at the contacts of relay r^2 . A similar set of relays r^3 and r^4 are connected across the calling end of the cord-circuit, an intermediate point of which connection is joined by conductor 13 with the live pole of said battery B . These relays similarly control the local circuit of the supervisory lamp S^3 , associated with the calling end of the cord-circuit.

For testing purposes the tip-strand t^2 of the cord-circuit is severed at the spring 14 of sleeve-relay r^4 , which normally connects, through conductor 15, with the high-resistance and high-impedance test-relay r^5 , which is grounded upon its other terminal. The operator's transmitter 16 is connected together with a retardation-coil 17 in a conductor 18, leading to the common wire 5^a , which is joined to the live pole of the battery B . The said transmitter is shunted by the primary helix of the operator's induction-coil 19 and by a suitable condenser c^3 . The

said test-relay serves, when energized, to ground the said shunt intermediate of the said condenser and primary helix. The secondary of the said induction-coil, the operator's receiver, and a suitable condenser are adapted to be connected in a bridge of the calling end of the cord-circuit by the springs 0 of any suitable listening-key. Springs 21 of the ringing-key are arranged, when actuated, to connect the ringing-generator 22 in a bridge of the calling end of the cord-circuit to thereby ring the subscriber's bell.

The subscriber A desiring a connection takes up his receiver, and thereby closes a path for current from the battery B through the differential windings of the relay R, which, owing to the difference in resistance of the two relays, is unbalanced and attracts its armature to close a local circuit of the line-signal. The operation of the signal attracts the operator's attention, whereupon the answering-plug P of her cord-circuit is inserted in the answering-jack of the line. This act places the supervisory relay r in shunt of the high-resistance winding 4 of the relay R and the supervisory relay r^2 in series with the low-resistance helix 6 of the said relay R. These relays and windings are so proportioned that under these conditions the magnetic effects of the current flowing through the two windings 4 and 6 of the relay R are equal and opposite, thus neutralizing the said relay and causing its armature to fall away and open the circuit of the lamp S to extinguish it.

Upon learning the number of the party wanted the line is tested in the usual way by touching the tip of the calling-plug to the test-ring of the multiple-jack before the operator. When the line is busy, the test-rings are raised to the potential of the battery B and a flow of current results through the test-relay r^5 , which responds and closes the circuit for current through the primary helix of the operator's induction-coil, and thereby causes a click in her receiver. If the line is idle, however, the test-rings are at the same potential as the tip of the plug, and consequently no flow of current results and no click is received. Upon finding the line idle, the calling-plug P² is inserted in one of the multiple-jacks of the line and the ringing-key depressed to call the wanted subscriber. The relay R of the called line does not respond to the ringing-current, so that the line-signal of that line remains unexposed and only the subscriber's bell is operated. After ringing the subscriber and before his response current flows through the sleeve-strand of the cord-circuit operating the sleeve supervisory relay r^4 ; but the relay R is so adjusted that the current through the winding 6 is not now sufficient to operate the same, and therefore the line-signal of the line called does not respond. The super-

visory lamp S³ is now lighted to indicate the failure of the called subscriber to respond. The tip-strand t^2 is closed for talking purposes through spring 14 and its forward contact of the relay r^4 . Upon the response of the called subscriber current flows over the metallic line and operates the supervisory relay r^3 to open the circuit of and extinguish the lamp S³.

During conversation the battery B furnishes current through the supervisory relays r and r^3 and over the telephone-lines for transmission purposes, the return-path for current being through the low-resistance winding 6 of the relay R. The line resistance is shunted by that of the sleeve supervisory relay r^2 or r^4 ; but with an average line a sufficient margin is obtained for satisfactory operation.

At the termination of the conversation the return of the receivers to the hooks opens the line-circuits, thereby deenergizing the tip supervisory relays and permitting the supervisory-lamp circuits to be closed. Upon observing these signals the operator takes down the connection and restores all parts to normal condition. It will be understood that the relays r^2 and r^4 remain energized when the line-circuits are open by current through the local path, including said relays and the winding 6 of the line-relay, the latter, as before explained, being adjusted so as not to respond to this current.

While the resistances mentioned are not intended to be arbitrary, good results have been secured, as before explained, when the supervisory relays are 100 and 500 ohms resistance and the windings of the relay R of 100 and 500 ohms, respectively. Under these conditions a sufficient margin is obtained when the total line resistance varies between 0 and 1300 ohms, the other apparatus being of the usual or desired dimensions. The grounds mentioned may be one and the same or the common office return, and the substation apparatus may be of any desired common-battery type.

I claim—

1. In a telephone system, the combination with a telephone-line, of an electromagnetic line signaling device having differentially-disposed windings and of different magnetic effects when calling-current from the substation flows through said windings, and means for equalizing the magnetic effects of said windings when a connection is established with the line to render the same inoperative, substantially as described.

2. In a telephone system, the combination with a telephone-line, of an electromagnetic line signaling device therefor having differential windings capable of developing different strengths of magnetic field when traversed by current in series, and means for equalizing the magnetic effects of said wind-

ings when a connection is established with the line, substantially as described.

3. In a telephone system, the combination with a telephone-line, of a line signaling device having two windings capable of producing different magnetic effects when traversed by the same current, a common source of current at the central office, means to operate said device by causing the same current to traverse said two windings in series, and means to render said device inoperative by causing a different current to traverse the two windings, substantially as described.

4. In a telephone system, the combination with a line signaling device having two differential windings disposed in the path of current when the subscriber is calling the central office, said windings being adapted to produce different magnetic effects as said current passes therethrough, and means for rendering said device inoperative when connection is established with the line, substantially as described.

5. In a telephone system, the combination with a telephone-line, of a line-relay therefor having two differential windings serially disposed in the path of current when the subscriber is calling the central office and responsive thereto, and means for rendering the same inoperative when a connection is established with the line, substantially as described.

6. In a telephone system, the combination with a telephone-line, of a line signaling device therefor having unequal differential windings disposed serially in the path of current when the subscriber is calling the central office, said device being responsive to such current, and means for rendering said device inoperative when a connection is established with the line, substantially as described.

7. In a telephone system, the combination with a telephone-line, of a line signaling device therefor having two differential windings, means for causing a current to flow through both said windings so as to produce a magnetic field in each and operate the same when a subscriber is calling central office, and means for causing current to flow through said windings so as to neutralize each other and render the same inoperative when a connection is established with the line, substantially as described.

8. In a telephone system, the combination with a telephone-line, of a line signaling device therefor having two unequal windings differentially disposed with reference to current in the line when the subscriber is calling the central office, said device responding to such current and means for causing current through said windings to produce equal and opposite effects when a connection is established with the line, whereby the same is

rendered inoperative, substantially as described.

9. In a telephone system, the combination with a telephone-line, of a line signaling device therefor having two unequal windings differentially disposed with reference to current in the line when the subscriber is calling the central office, whereby the same responds to such calling-current, a cord-circuit to establish conversational circuits with the line, supervisory apparatus associated therewith, and means whereby when a connection is established by the cord-circuit with the line, the magnetic effects of the two windings of the said device are neutralized and the supervisory apparatus is suitably actuated, substantially as described.

10. In a telephone system, the combination with a telephone-line, of a line signaling device having two windings, a cord-circuit to establish connections with the line, supervisory apparatus associated therewith including a pair of electromagnetic windings, means for connecting one of said windings in parallel with one of the windings of said device in the line-circuit, and means for connecting the other electromagnetic winding in a local circuit in series with the other winding of said device, substantially as described.

11. In a telephone system, the combination with a telephone-line, of a line signaling device having a high-resistance and a low-resistance winding, a cord-circuit to establish connections with the line, a supervisory apparatus, having a high-resistance and a low-resistance electromagnetic winding associated therewith, and means when the cord-circuit is connected with the line to connect said low-resistance supervisory winding in shunt of the high-resistance winding of said device and the high-resistance supervisory device in series with the low-resistance winding of the line signaling device, substantially as described.

12. In a telephone system, the combination with a telephone-line, of a line signaling device therefor, an electromagnet having windings thereon capable of producing different magnetic effects when traversed by the same current, a central battery, means to operate said magnet by current from said battery when a subscriber is calling the central office, and means to render said magnet inoperative when a connection is established with the line for conversation, said means being adapted to vary the current relation in said coils, substantially as described.

13. In a telephone system, the combination with a telephone-line, of a line signaling device having a high-resistance-winding and a low-resistance winding, one in each side of the line-circuit, a cord-circuit having a pair of supervisory relays associated therewith,

one of low resistance and the other of high resistance, a source of current associated with said relays and means for connecting the low-resistance relay in parallel with the
5 said high-resistance winding when a connection is established with said line, and a high-resistance relay in shunt with the line resistance and in series with said low-resistance winding, substantially as described.

10 14. In a telephone system, the combination with a telephone-line, of a magnetic line signaling device therefor, two windings for said device, means to energize the device when equal current flows through said wind-
15 ings and to deenergize the device by causing different currents to flow through the two windings, substantially as described.

20 15. In a telephone system, the combination with a telephone-line, of a line signaling device having a high-resistance winding and

a low-resistance winding, one in each side of the line-circuit, a cord-circuit having a pair of supervisory relays associated therewith, one of low resistance and the other of high resistance, a source of current associated
25 with said relays and having one pole connected directly thereto, and means for connecting the low-resistance relay in parallel with the said high-resistance winding when a
30 connection is established with said line, and the high-resistance relay in shunt with the line resistance and in series with said low-resistance winding, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 15th day of December, 1902.

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,
GAZELLE BEDER.