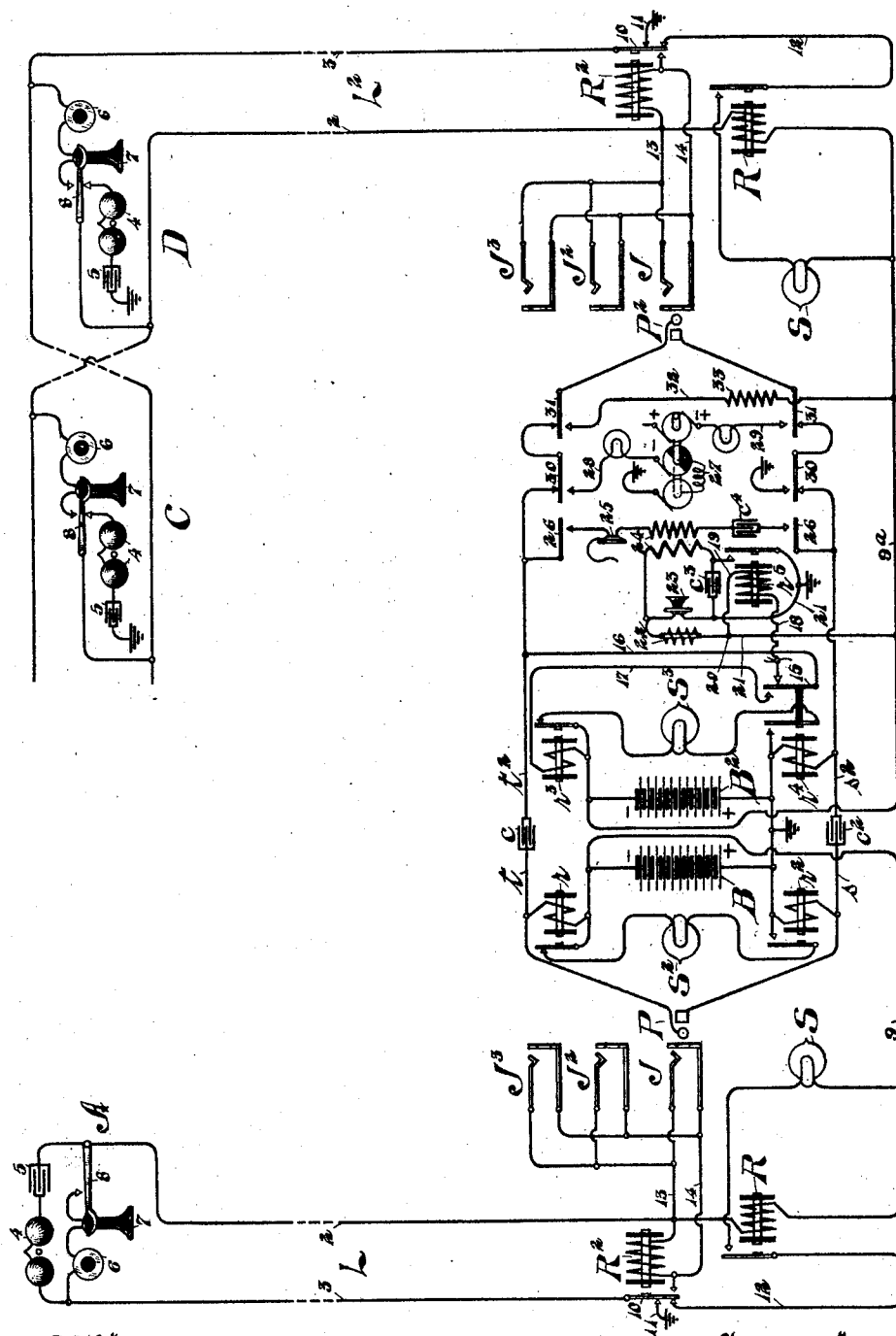


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H. G. WEBSTER.
TELEPHONE SYSTEM.
APPLICATION FILED DEC. 12, 1902.



Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 839,910.

Specification of Letters Patent.

Patented Jan. 1, 1907.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems of the common-battery type in which provision is made at the central office for variously connecting the subscribers together for conversational purposes and in which suitable apparatus is provided for supervising established connections.

This invention has for its objects the simplification of the circuits, connections and arrangements by which the above-mentioned operations are accomplished, and the provision of a system in which the said operations may be carried out in a rapid, positive, and efficient manner.

In the accompanying drawing, in which the same reference characters indicate similar parts throughout, the figure is a diagram of two subscribers' lines and the central-office apparatus employed in connecting the lines together.

L and L² indicate telephone-lines extending from their respective substations to the central office, the former line being shown as a single-station line, while the latter is indicated as of the polystation or party-line type. At the station A, located on the line L, the two line conductors 2 and 3 are preferably permanently bridged by an ordinary polarized call-bell 4 and a condenser 5, while a normally open bridge of the line conductors includes the transmitter 6, receiver 7, and the switch-hook 8. At the central office the tip conductor 2 permanently includes the winding of the line-relay R and is then connected by a conductor 9 with the live pole of the central and common battery B, the other pole of which is grounded. The other line conductor is connected with the spring 10 of the cut-off relay R² for the line and is thereby normally grounded through the branch conductor 11.

The individual signal for the line preferably consists of a small incandescent lamp S, which is energized from the battery B or othersuitable source and has its local circuit controlled through the normally open con-

tacts of the line-relay R, as well as through the normally closed contacts of the cut-off relay R², a conductor 12 extending between one of the normally open contacts of the line-relay R to one of the normally closed contacts of the cut-off relay R². Suitable connection-terminals, preferably in the form of spring-jacks J, J², and J³, are provided in multiple before the operators and have their tip-contacts joined by conductor 13 with the line conductor 2, while the sleeve-contacts of said jacks are conductively connected by conductor 14 with the forward contact of said spring 10 of the cut-off relay R². The winding of the cut-off relay R² is connected between the conductor 14 and the tip-conductor 2 or its continuation 13.

The line L² is provided at the central office with exactly similar apparatus as employed in connection with the line L, except that a common lead or omnibus bar 9^a extends to the live-pole of a second common battery or other common source of steady current B². The talking instruments at the substations are also connected in a normally open bridge of the line conductors; but the call-bells are placed in grounded branches from either side of the line and preferably from the normal contacts of the hook-switches.

At the central office the operators are provided with any desired number of cord-circuits, each of which includes an answering-plug P and the calling-plug P², having tip and sleeve contact-surfaces adapted to cooperate with the like contact surfaces of the connection terminals or jacks of the lines. The tip-contacts of the plugs of each pair are connected together by the flexible strands *t* and *t*² and the interposed condenser *c*, while the sleeve-contacts are likewise conductively joined by the similar strands *s* and *s*² and the interposed condenser *c*². The battery B is bridged across the answering end of the cord-circuit and includes in its connection thereupon either side the tip supervisory relay *r* and the sleeve supervisory relay *r*², which control, the former through its normally closed contacts and the latter through its normally open contacts, the local circuit of the supervisory signal S², which is preferably energized from the said battery B. The calling end of the cord-circuit is similarly connected with the battery B², upon either

side of which is provided the tip supervisory relay r^3 and the sleeve supervisory relay r^4 , which similarly control the local circuit of the supervisory lamp S^3 , associated with the calling-plug P^2 and preferably charged from the battery B^2 . These supervisory relays may each be of one-hundred-ohms resistance, the line-relay R of five-hundred-ohms resistance, the cut-off relay R^2 of fifteen hundred ohms, and the line of average resistance. While I do not wish to confine myself to these resistances, the system is operative with these proportions and with the resistance of an average line. It will be understood, however, that the relative proportions may require modification under different conditions of use.

For the purpose of testing the busy or idle condition of the telephone-lines the branch which connects the supervisory relay r^3 with the tip conductor 2 is normally severed at the spring 15 of the sleeve supervisory relay r^4 , which spring is normally connected with the branch 16, permanently connected with said tip-strand, while the remaining portion 17 of the connection of said relay with the tip-strand is connected with the forward contact of said relay-spring 15. The normal contact of said spring is connected by conductor 18 with the preferably high-resistance and high-impedance test-relay r^5 , which is joined by conductor 19 to the point 20, located upon conductor 21, that is connected with the lead 9^a. This test-relay is preferably common to the cord-circuits belonging to each operator. The said conductor 21 includes the retardation-coil 22, the operator's transmitter 23, and is thence grounded. The primary winding of the operator's induction-coil 24 and a condenser c^3 are connected in shunt of the transmitter 23. The grounded spring of said test-relay closes through its forward contact a conductive path from a point on said shunt between the condenser c^3 and the said primary winding. The operator's receiver 25, the secondary of her induction-coil 24, and a condenser c^4 are adapted to be bridged across the calling end of the cord-circuit by the springs 26 of a suitable listening-key.

A ringing-generator 27 is connected on one side to ground and upon the other side is arranged to deliver negative pulsating current through a suitable resistance-lamp over conductor 28 to the tip side of the line and also to furnish alternating current through a suitable lamp over conductor 29 with the sleeve side of the cord-circuit and the telephone-line. The depression of the springs 30 of the ringing-key, therefore, connects the generator with the tip-strand of the cord-circuit while the sleeve-strand is grounded, and the operation of springs 31 of the said key connects the generator with the sleeve-strand and provides a new path for current from the bat-

tery B^2 over the tip-strand through conductor 32 and the fifty-ohm coil 33.

The operation is as follows: Taking up the receiver at the station A closes the line conductors together, with the result that current flows from the live pole of the battery B , over the lead 9, through the line-relay R , thence over the line conductor 2, through the substation instruments, and back to the central office, over the line conductor 3, and through the spring 10 and branch 11 to ground. The current in this path energizes the line-relay R , which closes the local circuit of the signal-lamp S and permits current to flow there-through from the lead 9, through the closed contacts of the line-relay R , and thence over conductor 12, the spring 10 of cut-off relay R^2 , and branch 11 to ground. The operator observing the line-signal inserts the answering-plug P in the answering-jack J , with the result that the battery B is included in a local circuit with the cut-off relay R^2 , said circuit including the tip and sleeve strands of the cord-circuit and the jack conductors 13 and 14. Although of high resistance, this cut-off relay is adjusted to respond to current over this path even though it is shunted by the line conductors. Its operation cuts off the ground branch 11 and also opens the local circuit of the line-lamp S . The line-relay R also opens the circuit of the signal S for the reason that it is shunted by the supervisory relay r . The supervisory relay r^2 is energized over the same path as the cut-off relay R^2 and closes the local circuit of the supervisory lamp S^2 . This lamp does not light, however, on account of the operation of the tip-relay r , which serves to open this circuit. The sleeve-relay r^2 is adjusted to respond to the current flowing through it whether or not the subscriber's line is open, whereby it serves to close the circuit of the lamp S^2 while a connection is up. The supervisory relay r is adjusted to respond only to the current flowing through it when the subscriber's instrument is in use, whereby as soon as the line-circuit is opened by the return of the receiver to its hook the said relay is deenergized and the lamp lighted. Upon receiving the order for the connection the operator tests the condition of the wanted line. Under normal conditions it will be seen that the test-rings of the jacks are connected through the conductor 14, the winding of the cut-off relay R^2 , and thence by leads 9 or 9^a with the live pole of a battery. Inasmuch as the tip of the cord-circuit is likewise connected and is raised to the full potential of the battery, no "click" will be received when an idle line is tested. If a plug has been inserted in any of the jacks of the line, this connects the test-rings thereof with the grounded pole of a battery, so that the application of the tip of a testing-plug to a different test-ring of the line would cause a flow of current over the tip-

cord strand and would cause a click in the operator's receiver. This click is caused in the following manner: The testing-current flows over the tip-strand, spring 15 of supervisory relay r^4 , conductor 18, through the test-relay r^5 , conductor 19, and conductors 21 and 9^a to the live pole of the battery. The test-relay responds to this current and closes a ground branch from the operator's shunt, which permits a flow of current through the primary of her induction-coil. Upon finding the line idle a calling-plug is inserted in the jack and the ringing-key operated. The operation of the springs 31 connects the generator with the sleeve conductor, thereby sending alternating current out over the sleeve side of the line and through the bell at the station C, thus operating the same. At the same time the tip-spring 31 connects with the conductor 32 through the coil 33, and thus provides an auxiliary path for current through the cut-off relay to maintain the same operated and a low-resistance return-path for ringing-current in case the subscriber answers during ringing or in case the said springs are operated for calling a single subscriber located upon a metallic line. The operation of the tip-springs 30 connects the generator with the tip line conductor to operate the bell at station D, while the sleeve conductor is grounded to provide a low-resistance path. This ringing-current is, moreover, pulsating in character, whereby the cut-off relay is readily held up by the same, and it is preferably of the same polarity as that impressed upon the line by the battery B². After ringing and before the subscriber responds the sleeve supervisory relay r^4 operates to disconnect the test-relay and complete the connection between conductors 16 and 17 through the relay r^3 . At the same time the relay r^4 closes the local circuit of the supervisory lamp S³, and since the relay r^3 is not yet operated the said lamp is lighted to indicate the fact of the non-response of the subscriber to the operator. As pointed out, the cut-off relay R² and the supervisory relay r^4 are now included in a local circuit with the battery B², said local circuit including two parallel branches, one leading through the line-relay R and the other through the supervisory relay r^3 . These relays are so adjusted that under these conditions the supervisory relay r^4 and the cut-off relay R² are energized while neither the line-relay R nor the supervisory relay r^3 are operated. Upon the response of the called subscriber, however, these conditions are changed to the extent that the supervisory relay r^3 now responds to effect the opening of the circuit of the lamp S³. During conversation the battery B furnishes current to the line L for transmission purposes and for the operation of the various relays associated therewith. The battery B² similarly provides the line L² with

operating-current. At the termination of the conversation when the receivers are returned to their hooks the tip supervisory relays r and r^3 are deenergized and the lamps S² and S³ energized. As before pointed out, the cut-off relay R² and the sleeve supervisory relays remain energized, while the line-relays do not respond and the line-signals are not lighted. The operator observing the signals takes down the connection and restores all parts to normal position. It will be understood that any other substation instruments adapted for common-battery transmission may be employed, that the several grounds referred to at the central office are usually one and the same, or they may be the common-office return, and that the batteries shown are preferably common to the exchange.

I claim—

1. In a telephone system, the combination with a telephone-line, of a line-relay and a source of current connected therewith, a cut-off relay adapted when operated to connect one side of the line with one contact of the jack, a cord-circuit to establish connections with the line, and a supervisory relay associated with the cord-circuit and adapted to be connected in shunt with said line-relay during the time when a connection is established, said cut-off relay being also operated when a connection is made, substantially as described.

2. In a telephone system, the combination with a telephone-line, of a line-signaling device and a source of current normally connected with the line, a cut-off relay adapted to be bridged across the line during conversation, and a supervisory relay associated with the cord-circuit and adapted to shunt said line-signaling device during the time 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-relay and a source of current normally connected therewith, a cut-off relay for the line, a pair of supervisory relays one upon each side of said source, and means for including one of said relays in a local circuit with said source and the cut-off relay whereby they are operated during the time that the connection is established, the other supervisory relay being arranged to shunt the line-relay whereby the latter is rendered inoperative, substantially as described.

4. In a telephone system, the combination with a telephone-line, of a line-relay, and a source of current for the line, a cut-off relay, a pair of supervisory relays for the line, means for including the said source, one of the supervisory relays and the said cut-off relay in a local circuit, said local circuit including parallel branches, the line-relay being located in one of said branches, and the

other supervisory relay in the other of said branches, substantially as described.

5. In a telephone system, the combination with a telephone-line, of a high-resistance cut-off relay therefor, a cord-circuit, a supervisory relay associated therewith, said supervisory relay being of low resistance and having a current flowing through its coil whenever the cord is connected with a line, and being adjusted to respond to current in the line during the time the subscriber's instrument is in use, but to be irresponsive to the current through its coil when the line-circuit is open, substantially as described.

6. In a telephone system, the combination with a telephone-line, of a plurality of spring-jacks or connection-terminals therefor, the contacts of said jacks upon one side of the circuit being permanently connected with the line conductor, and the contacts upon the other side of the circuit being normally disconnected from the corresponding conductor, and a cut-off relay for the line independently bridged thereacross and adapted when operated to connect said disconnected terminals with the line conductor, substantially as described.

7. The combination with a telephone-line, of a high-resistance line-signaling device, a cut-off relay for the line adapted to be bridged across the talking-circuit during conversation, a supervisory signal adapted to be connected in shunt of the line-signaling device during the time when a connection is estab-

lished, said cut-off relay being operated at the same time to render the line-signal inoperative, substantially as described.

8. In a telephone system, the combination with a plurality of telephone-lines, a line-relay for each of said lines, a cord-circuit to connect said lines together for conversation, two supervisory relays for said cord-circuit, one adapted to be connected in series, and the other in parallel with said line-relay while the cord-circuit is connected with the line, substantially as described.

9. In a telephone system, the combination with a telephone-line, of a line and a cut-off relay for said line, and means whereby current will pass through said line and cut-off relays in series during connection with said line, substantially as described.

10. In a telephone system, the combination with a plurality of telephone-lines, of a cord-circuit to connect said lines together for conversation, two supervisory relays for said cord-circuit, a cut-off relay for said line adapted to be actuated in series with said supervisory relays and in parallel with one of said lines, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 10th day of December, 1902.

HARRY G. WEBSTER.

Witnesses:

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