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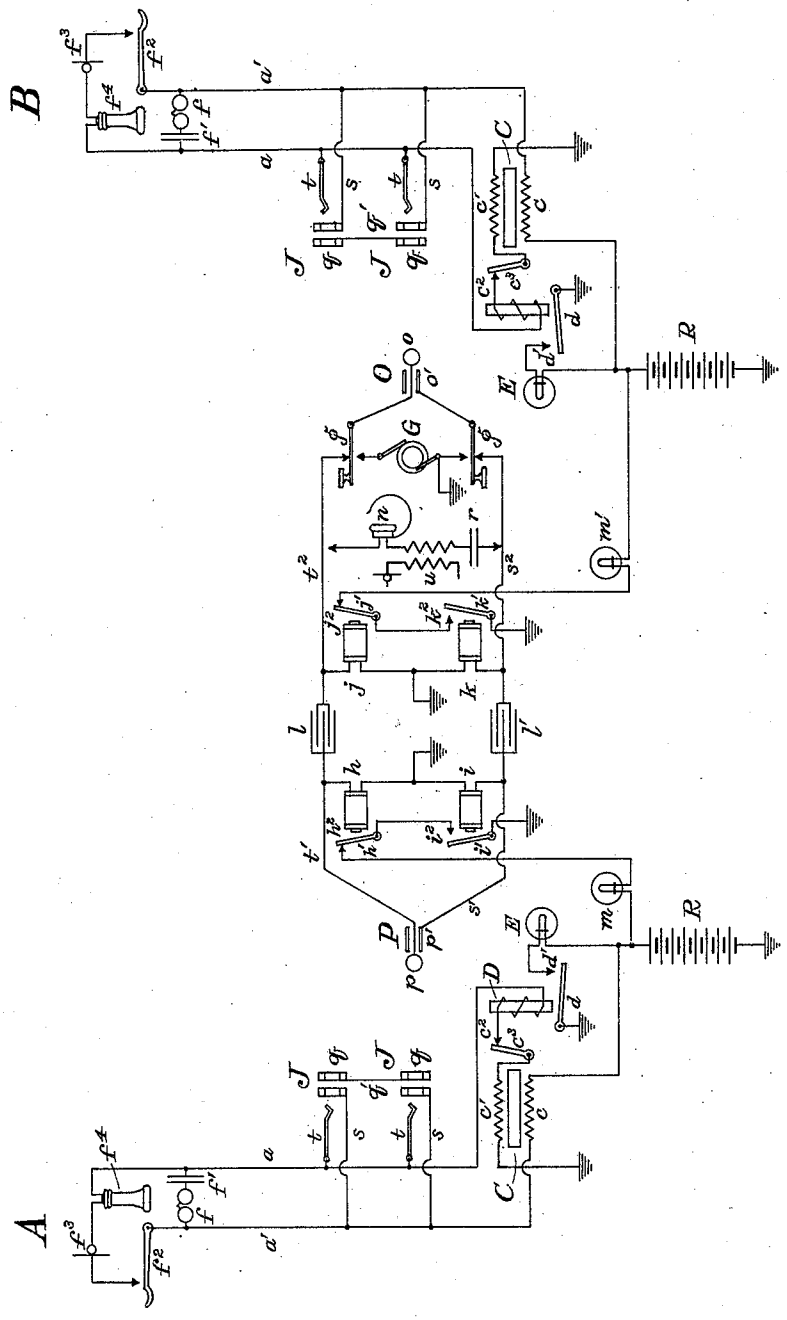
F. W. DUNBAR.

TELEPHONE SYSTEM.

APPLICATION FILED MAY 8, 1901.



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TELEPHONE SYSTEM.

No. 842,306. Specification of Letters Patent. Patented Jan. 29, 1907.

Application filed May 8, 1901. Serial No. 59,193.

To all whom it may concern:

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

My invention has for its object the production of a system for rapid telephone intercommunication wherein all sources of current-supply are located at the central office and wherein all signals from the subscriber to the central office are sent automatically on the part of the subscriber. More specifically, its object is to simplify the circuits and apparatus necessarily used in connection with them and to render positive the operation of all signals, doing away entirely with the necessity of marginal adjustments.

In this invention a differentially-wound cut-off relay is provided the coils of which have an approximately equal number of turns, so that the relay will be rendered neutral when the same current is flowing in different directions through its two windings. In series with the two windings of the cut-off relay and normally in the metallic circuit of the line is the coil of the line-relay and a battery or other source of suitable current. Owing to the differential winding on the cut-off relay the line-relay may be operated over the line-circuit without energizing the cut-off relay. Means are provided, however, so that when a connection is made with the line the coils of the cut-off relay are unbalanced, and this relay is therefore operated, thus opening the circuit of the line-relay and rendering it inoperative. The system in this case differs from others employing cut-off relays in the line-circuit in the particular method of rendering the cut-off relays inoperative to signals sent by the subscriber and of rendering it operative when connection is made with a line. It also differs in respect to the method of operating the supervisory signals.

My invention is shown in the accompanying drawing, in which—

A and B represent, respectively, the stations of two subscribers' lines. These are connected by line-wires a and a' in each case, with the tip-springs t and sleeve-contacts s of the various jacks J at the central office. The sleeve side of the line a' is connected with one terminal of the winding of the cut-off relay C, the other terminal of this winding being connected to one pole of the battery R, the other terminal of which battery is grounded or run to a common office-return.

The tip side of the line a is connected, as shown, to one terminal of the coil of the line-relay D, the other terminal of which is connected to the back contact c^2 of the cut-off relay C. The armature c^3 of the cut-off relay C is connected to one terminal of the coil c' of the cut-off relay, the other terminal of which is grounded, so that when the cut-off relay is not actuated circuit may be traced from the limb a of the line through the coil of the line-relay D, contacts c^2 and c^3 of the cut-off relay C, and through the coil c' of the cut-off relay to ground. The line-relay D controls by its contacts d and d' the circuit of the line-lamp E in an obvious manner. Each jack J, when this system is used as a multiple board, is provided with an extra test-thimble q, all the test-thimbles of one line being connected together by the wire q'. Where the system is not large enough to require the use of a multiple board, then the thimbles q and their connecting-wire q' may be omitted, they having under such conditions no function.

The apparatus at the subscriber's station consists of a bell f and condenser f', bridged across the line in the usual manner, and also of a hook-switch f^2, a transmitter f^3, and a receiver f^4, the functions of all of which are well understood. While the receiver is on its hook, the circuit between the two limbs of the line is held open by means of the condenser; but when the receiver is removed from its hook the circuit is made complete through the talking apparatus.

A pair of connecting-plugs, with their accompanying cord-circuit, is shown in the center of the figure.

P O are respectively the answering and calling plugs, each having a tip and a sleeve contact. The condenser l is interposed between the tip-strands t' and t^2, which connect with the tip-contacts p of the plugs P and O, respectively. In a similar manner the condenser l' is interposed between the strands s' and s^2, connecting with the sleeve-contacts p' and o', respectively, of the two plugs. Between the strands t' and s' are

bridged the coils of the two relays h and i, connected together in series, and between the strands t^2 and s^2 in a similar manner are bridged the coils of the relays k and j. The points between the windings of these two pairs of relays are grounded. The relays h and j each have a pair of normally closed contacts h' h^2 and j' and j^2, respectively, adapted to be opened when the relays are energized. The relays i and k each have a pair of normally open contacts i' i^2 and k' k^2, respectively.

In series with the battery R and the contacts of the relays h and i is the supervisory lamp m. The supervisory lamp m' is similarly connected in series with the battery and the contacts of the relays j and k. It is obvious that the lamp m will be lighted only when the relay h is unactuated and the relay i is actuated. Similarly the lamp m' will be lighted only when the relay j is unactuated and the relay k is actuated.

An operator's circuit containing a head-telephone n, an induction-coil u, and a condenser r is adapted to be bridged across the strands t^2 and s^2 in the ordinary manner.

The generator G is adapted to be bridged across the strands of the calling-cord O by means of the ringing-key g, which key when operated serves to break the cord-circuit back of the generator in the ordinary manner.

The operation of the system is as follows: When the subscriber at A removes his receiver from its hook, circuit is closed between the limbs a and a' of the line. Current therefore flows from the battery R through coil c of the cut-off relay C, limb a' of the line, subscriber's apparatus, limb a of the line, coil of the line-relay D, contact c^2 and c^3 of the cut-off relay, and to ground through the coil c' of the cut-off relay C. As this current passes in opposite directions through the two windings of the relay C this relay is not operated. The relay D, however, is operated and by closing its contacts d and d' lights the line-lamp E as a signal to the operator. The operator on seeing a lamp thus lighted inserts one of her answering-plugs P into the jack of the corresponding line. This act connects the cord-circuit with the line-circuit and enables the operator to communicate with the subscriber after she has operated her listening-key. The insertion of the plug also places the coil of relay h in a shunt-path around the coil of the line-relay D and the coil c' of the cut-off relay C in series, this shunt-path being traced from the limb a of the line through tip-spring t, tip-contact p, tip-strand t', and relay h to ground. This serves to materially diminish the current flowing in the coil c' of the cut-off relay and at the same time to increase the current flowing in the coil c of the cut-off relay. This unbalances the effects of the windings of the cut-off relay and causes it to attract its armature, and thus break the circuit of the line-relay D, rendering it inoperative. The passage of current through the coil of relay h energizes that relay, causing it to open its contacts, thus opening the circuit of the supervisory lamp m. The insertion of the plug into the jack also serves to actuate the relay i over the following path: from the live side of the battery R through the winding c of the cut-off relay C, sleeve s of the jack, sleeve p' of the plug, winding of relay i, and to ground. This relay attracts its armature and closes its pair of contacts in the local circuit of lamp m. The relay i thus holds its pair of contacts in the lamp-circuit closed as long as a plug is inserted in the jack. The relay h is, however, under control of the subscriber with whose line the corresponding plug is connected, and when the subscriber hangs up his receiver after finishing a conversation the circuit through the relay h is broken, and it therefore releases its armature and closes the circuit of the lamp m as a signal to the operator. The lamp m' is controlled by the relays j and k in exactly the same manner as described in connection with the lamp m and the relays h and i.

In order to determine whether or not a line is busy before making a connection with it in response to a call, the operator touches the tip of the plug O to the test-ring q of the jack of the line called for. If the line is not busy, the test-rings q q at that line will be insulated from all other parts of the system, and the electrical conditions will not be changed by the contact of the tip of the plug O. If, however, the line is busy by virtue of its being connected at another section of the switchboard, the test-ring q of that line will be charged to a certain potential above that of the ground or common return by virtue of its being crossed with the sleeve-contacts s belonging to that line by the insertion of the plug at the other section. When the operator makes the test under such conditions, the difference of potential between the two sides of her cord-circuit is altered, and she obtains a click in her head-receiver n. It is obvious that other well-known forms of test may be used, and I do not desire to limit myself to the particular one here shown. Having learned that the line is not busy, the operator inserts the plug O into the jack and by operating her ringing-key g attracts the attention of the subscriber in the usual manner. The ground or common return connection shown on the sleeve side of the generator G serves to complete the circuit from battery R through the coil c on the cut-off relay C and thence through the sleeve-contact of the jack J, the sleeve-contact o' of the plug O, and thence to ground, thus operating the cut-off relay C and preventing the line-lamp E from lighting while the operator is sending the ringing-current to the subscriber.

When two subscribers are connected, their

line-lamps are rendered inoperative; but the supervisory lamps are placed under control of the two lines, respectively. When both supervisory lamps are lighted, the operator knows that both subscribers have hung up their receivers and pulls down the connection. Either subscriber may attract the attention of the operator by alternately raising and lowering his hook, thus causing a "winking" of the corresponding lamp.

Having now described my invention, what I claim is new, and desire to secure by Letters Patent, is—

1. In a telephone system, the combination with a line-circuit, of a cut-off relay having two differentially-wound coils in said line, a battery and a line-relay associated in said line, a cord-circuit for making connections with the line for conversation, a supervisory relay of comparatively low resistance associated with the cord-circuit, and means when a connection is established with the line for shunting one of the coils of said cut-off relay through said supervisory relay, whereby said cut-off relay is actuated and said line-relay is cut out of circuit, substantially as described.

2. In a telephone system, the combination with a line-circuit, of a cut-off relay having two differentially-wound coils in said line, a battery and a line-relay also in said line, a cord-circuit for making connections with the line for conversation, a supervisory relay of comparatively low resistance associated with the cord-circuit, and means when connection is established with the line for shunting one of the coils of said cut-off relay and said line-relay through the winding of said low-resistance supervisory relay, whereby said cut-off relay is actuated and said line-relay is cut out of circuit, substantially as described.

3. In a telephone system, a line-circuit, a cut-off relay having two differentially-wound coils in the line, a battery and a line-relay also in the line, a cord-circuit for making connection with the line for conversation, a supervisory relay of comparatively low resistance associated with the cord-circuit, and means when a connection is established with the line for shunting one of the coils of said cut-off relay and said line-relay through the winding of said low-resistance supervisory relay, whereby said cut-off relay is actuated and the shunted winding thereof and the line-relay are cut out of circuit, substantially as described.

4. In a telephone system, a line-circuit, a cut-off relay having two windings in the line, a line-relay, one winding of said cut-off relay and said line-relay being connected in series with the tip side of the line, a cord-circuit for making connections with the line for conversation, a supervisory relay of comparatively low resistance associated with the tip-strand of the cord-circuit, and means when a connection is established for conversation for shunting the tip-winding of said cut-off relay and said line-relay through said low-resistance supervisory relay, substantially as described.

5. In a telephone system, a metallic-circuit line, a cut-off relay having two differential windings, a line-relay, one winding of said cut-off relay and said line-relay being connected in series with the tip side of the line, the other winding of said differentially-wound relay being included in series with a battery in the sleeve side of the line, a cord-circuit for making connections with the line for conversation, a supervisory relay of comparatively low resistance associated with the tip-strand of the cord-circuit, and means for connecting the tip-winding of the cut-off relay and said line-relay in shunt with said low-resistance supervisory relay when a connection is established with the line, whereby said cut-off relay is actuated and the line-relay is cut out of circuit, substantially as described.

6. In a telephone system, a line-circuit, a differentially-wound cut-off relay having one winding connected in series with a battery in the sleeve side of the line, the other winding of said cut-off relay being connected with the tip side of the line, a suitably-controlled line-signal for the line, a cord-circuit for making connections with the line for conversation, a supervisory relay of comparatively low resistance associated with the tip-strand of the cord-circuit, and means when a connection is established with the line for connecting the tip-winding of the cut-off relay in shunt with said supervisory relay, whereby the line-signal is effaced, substantially as described.

7. In a telephone system, a metallic-circuit line connected for conversation, a source of current bridged between one limb of said circuit and ground, two relays bridged across said circuit, each having one terminal connected to ground, whereby one of said relays is constantly actuated and means at the subscriber's station for closing the metallic circuit, whereby the other of said relays is actuated and a supervisory signal having its circuit controlled by said relays, substantially as described.

8. In a telephone system, a metallic-circuit line connected for conversation, a source of current bridged between one of the limbs of said line and ground, two relays connected in series across the metallic circuit, one terminal of one of said relays being grounded, whereby said relay is constantly actuated, means at the subscriber's station for closing circuit of said line, whereby the other of said relays is actuated, a local circuit containing a signal controlled by the mutual action of both of said relays, substantially as described.

9. In a telephone system, a metallic-circuit line and a source of current connected be-

tween one of its limbs and ground, a cord-circuit adapted to connect with said line, having two relays bridged across its two strands, a ground connection for one of said relays, whereby said relay is actuated, while connection is made with the line to close a local circuit, means at the subscriber's station for closing the metallic circuit, whereby the other of said relays is actuated to open said local circuit, and a signal included in said local circuit, substantially as described.

10. In a telephone system, a line-circuit, a cut-off relay having two windings in the line, one of said windings being connected in series with a battery in the sleeve side of the line, a line-relay, the other winding of said cut-off relay being connected in series with said line-relay in the tip side of the line, a line-signal having its circuit controlled by said line-relay, a cord-circuit for making connections with the line for conversation, a low-resistance supervisory relay associated with the tip-strand of the cord-circuit, and means when a connection is established with the line for shunting said line-relay and the tip-winding of said cut-off relay through said supervisory relay, whereby the line-signal is effaced, substantially as described.

11. In a telephone system, a line-circuit, a cut-off relay having two windings in the line, a battery and a line-relay also in the line, a cord-circuit for making connections with the line for conversation, a pair of supervisory relays for the cord-circuit and means when connection is established with the line for unbalancing said cut-off relay by current through one of said supervisory relays, whereby the line-relay is cut out of circuit the other of said supervisory relays being under the control of the subscriber and a supervisory signal controlled by said pair of supervisory relays, substantially as described.

12. In a telephone system, the combination with a plurality of telephone-lines, of a cord-circuit to connect said lines for conversation, a central source of current, a differential cut-off relay for each of said lines, a high and low resistance supervisory relay bridged in series across said cord-circuit and each connected to the same pole of said central source, means upon the connection of said cord-circuit with a line to include said high-resistance relay in a local circuit in series with one coil of said cut-off relay to actuate each and upon the response of the called subscriber to include said low-resistance relay in the path of current over the line, a signal controlled by said cord-relays, and the normal path of current to the line controlled by said cut-off relay, substantially as described.

In witness whereof I hereunto subscribe my name in the presence of two witnesses.

FRANCIS W. DUNBAR.

Witnesses:
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