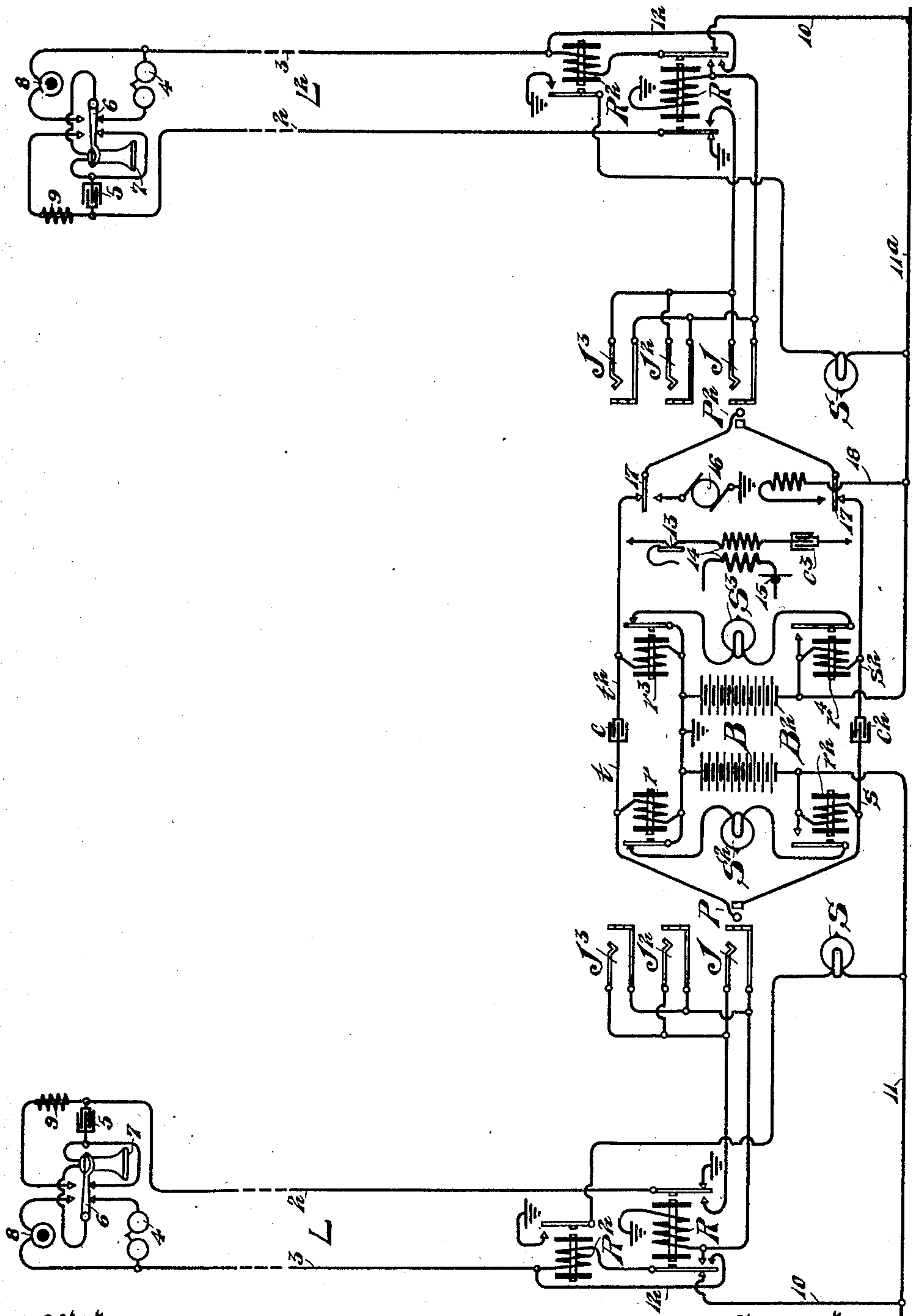


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TELEPHONE SYSTEM.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

No. 912,822.

Specification of Letters Patent.

Patented Feb. 16, 1909.

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*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 Telephone Systems, of which the following is a specification.

My invention relates to telephone systems of the two-wire type in which the cut-off relays are actuated by current over the talking circuit. In systems of this class it is common to provide each of the telephone lines with a line signal, the circuit of which is controlled by means of a relay that is normally associated with the telephone line; and, in addition, to associate with each line, a cut-off relay which when the operator's circuit is connected with the line is operated to cut off the line relay to render the line signal inoperative. A central source of current common to the exchange is also normally connected with the telephone lines, but when the cut-off relay is operated the normal connection of said source is opened and a temporary connection established therewith through the medium of the cord circuit.

In my present invention I associate with each line a line signal and a line relay, the relay controlling normally open contacts in the local circuit of said signal. In addition a cut-off relay is provided for each of the lines which is adapted when the operator connects her cord circuit with the line to establish a path of low resistance about the line relay, which is permanently connected in the telephone line to cause the same to release its armature and thereby open the circuit of the line signal to retire the same, or in case the line signal has not yet been operated to prevent its operation during the time that the connection is established.

In connection with the cord circuit I provide a supervisory signaling system through the medium of which, supervisory signals that are associated with the respective plugs of the cord circuit are adapted to individually indicate the condition of the subscribers' telephones during conversation. A suitable ringing outfit is also provided for the operator by means of which she is enabled to call any desired subscriber.

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

In this figure, L and L<sup>2</sup> indicate two subscribers' lines extending in two limbs 2 and 3 from their respective substations to the central office. At the substation each subscriber is provided with an ordinary signaling bell 4 and a condenser 5 in a bridge of the line conductors which is normally closed at the switch-hook 6, upon which the receiver 7 is adapted to be suspended when not in use. When the receiver is lifted from the switch-hook, it is suitably connected in circuit with the transmitter 8, the retardation coil 9 and the condenser 5. Any other suitable or desired common battery outfit may obviously be employed.

At the central office the line is provided with a signal S and an answering jack J, and a plurality of multiple jacks J<sup>2</sup> and J<sup>3</sup> in any desired number. The switchboard section of the telephone line is normally disconnected from the external section, the line conductor 2 being normally grounded through a spring of the cut-off relay R, the winding of which is legged to ground from the sleeve conductor of the switchboard section, but is adapted when the said relay is operated to be disconnected from ground and connected with the tip side of the switchboard section. The sleeve conductor 3 of the telephone line includes the winding of the line relay R<sup>2</sup>, which controls through its normally open contacts the local circuit of the line signal S, and is thence connected with a second spring of the cut-off relay R, whose normal contact is joined by a branch conductor 10 with the bus bar 11 leading from the live pole of the central common battery B. When the said cut-off relay is actuated, said spring is disengaged from the conductor 10 and connects with the sleeve side of the switchboard section of the telephone line. A shunt circuit, consisting of the branch conductor 12 is adapted to be connected around the line relay R<sup>2</sup> by the said sleeve spring and forward contact of said cut-off relay R, whereby when said cut-off relay is operated, said line relay is shunted and is thereby deprived of operating current so that its armature may not be attracted and the local circuit of the line signal is opened.

Each operator is provided with a plurality of cord circuits each of which circuits is provided with an answering plug P and a calling plug P<sup>2</sup> having tip and sleeve contacts adapted to register with the corresponding con-



tacts of the spring jacks when inserted therein. The tip contacts of said plugs are electrically united through the flexible strands  $t$  and  $t^2$  and the interposed condenser  $c$ , and their sleeve contacts are similarly joined by the strands  $s$  and  $s^2$  and the interposed condenser  $c^2$ . A pair of supervisory relays  $r$  and  $r^2$  are together with the battery B bridged across the answering end of the cord circuit, the former relay serving when operated to open the local circuit of the supervisory signal  $S^2$  associated with the plug P and the latter relay serving when excited to close the circuit of said signal. A similar pair of supervisory relays  $r^3$  and  $r^4$  are together with a second common battery  $B^2$  bridged across the calling end of the cord circuit and control in a similar manner the supervisory signal  $S^3$  which is associated with the calling plug  $P^2$ . The operator's set comprising a head receiver 13, the secondary of an induction coil 14, and a suitable condenser  $c^3$  are adapted to be bridged across the calling end of the cord circuit through the medium of any suitable listening key, while her transmitter 15 and the primary winding of her induction coil are adapted to be included in a local circuit with any suitable source of current, which may be either the battery B or  $B^2$ . A ringing generator 16 is adapted to be connected between ground and the tip contact of the calling plug through the employment of a suitable ringing key 17, the sleeve spring of which key at the same time serves to connect the sleeve contact of the plug with the auxiliary conductor 18, containing a suitable resistance and which is connected with the second common battery lead or omnibus bar  $11^a$ , that leads from the live pole of the battery  $B^2$ .

In the operation of the system, the subscriber upon line L for example, takes up his receiver, and thereby completes a path for current over his metallic line from the live pole of the battery B over conductors 11, 10 and 3, including the winding of the line relay  $R^2$ , thence through the substation devices and back over the line conductor 2 to the central office and ground. The line relay  $R^2$  is thus operated and serves to close the local circuit of the line signal S which is lighted to attract the attention of the operator. Upon observing this signal the operator inserts the answering plug P of her cord circuit in the answering jack of the telephone line and depresses her listening key to connect her set with the cord circuit. The insertion of the said plug includes the battery B together with supervisory relay  $r^2$  and the cut-off relay R in a local circuit, thus operating the cut-off relay and thereby severing the normal connections of the line conductors 2 and 3 and joining them with the switchboard section of the telephone line. Simultaneously the shunt 12

is closed about the line relay  $R^2$ , which being thus deprived of operating current releases its armature and opens the local circuit of the line signal S to retire the same. The supervisory relay  $r^2$  is actuated at the same time but owing to the presence of the current flowing over the metallic line and through the tip supervisory relay  $r$ , the signal  $S^2$  is prevented from operating and accordingly remains inert. Upon learning the order of the calling subscriber the wanted line is tested in the usual manner by touching the tip of the calling plug to the test ring of the multiple jack at the section of the switchboard at which the connection has been initiated, a click being received by the operator when the line is busy and no click when the line is idle. Finding the line idle the calling plug is inserted and the ringing key depressed. Any ordinary type of ringing key may be employed, but preferably one in which both springs are simultaneously operated. Thus the ringing generator is connected with the tip side of the line and sends current out over the telephone line with return through the sleeve conductor of the switchboard section, the forward portion of the sleeve strand of the cord circuit, conductors 18 and  $11^a$ , and through the battery  $B^2$  to ground. At the same time the cut-off relay of the called line is maintained actuated by current from the battery  $B^2$  over conductors  $11^a$  and 18 and through the cut-off relay to ground. The ringing current is thus shunted around the supervisory relay  $r^4$  to prevent the same from chattering. After the subscriber has been called but before his response, current flows through the supervisory relay  $r^4$  and the cut-off relay of the telephone line in a local circuit, said supervisory relay serving to close the circuit of the supervisory signal  $S^3$  which is lighted to indicate to the operator that the subscriber has not yet responded. As soon as he does respond current is permitted to flow over his metallic line and the supervisory relay  $r^3$  is actuated to open the local circuit of and retire the said signal  $S^3$ . During conversation the batteries B and  $B^2$  are sending current out over the two telephone lines to provide the substation instruments with operating current and to actuate the several relays at the central office. The voice currents are readily propagated from one circuit to the other through the medium of the condensers  $c$  and  $c^2$  in the cord circuit. At the termination of the conversation, the subscribers return their receivers to the switch-hooks with the result that the metallic circuits are open to steady currents and the supervisory relays  $r$  and  $r^3$  in the cord circuits are deenergized thus permitting the lighting of the supervisory signals  $S^2$  and  $S^3$ , since the said supervisory relays  $r^2$  and  $r^4$  remain



actuated. Upon observing these signals the operator withdraws the plugs P and P<sup>2</sup>, thus again opening at the relays r<sup>2</sup> and r<sup>4</sup> the local circuits of the supervisory signals and retiring the same. The cut-off relays are simultaneously deenergized and all parts are restored to normal condition.

Having thus described my invention what I claim and desire to secure by Letters Patent is:—

1. In a telephone system, the combination with a telephone line, of a central source of current therefor, a cut-off relay having contacts normally connecting the poles of said source with the limbs of said telephone line, and a line relay normally in series with the line and adapted to be shunted by the actuation of said cut-off relay, substantially as described.

2. In a telephone system, the combination with a telephone line, of a source of current at the central office, a cut-off relay having contacts normally connecting said source with the limbs of the telephone line, a line relay normally in series in the line, a cord circuit adapted when connected with the line to complete the energizing circuit for said cut-off relay, the actuation of said cut-off relay being adapted to complete a shunt about the line relay, whereby said relay becomes inoperative, substantially as described.

3. In a telephone system, the combination with a telephone line, of a source of current at the central office, a cut-off relay having contacts normally connecting the limbs of said line with the poles of said source, a line relay adapted to receive current from said source when the cut-off relay is in its normal position and the line is closed at the substation, the actuation of said cut-off relay being adapted to sever the normal connection of said line with said source and to complete a shunt about said line relay whereby it becomes inoperative, substantially as described.

4. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith, a source of current at the central office, a cut-off relay for the line having contacts normally connecting a limb of said line with a pole of said source, a line relay in said limb of the line adapted to be actuated when the line is closed at the substation, said cut-off relay being adapted to be actuated to complete a shunt about the line relay and to sever the normal connection between said limb of the line and said pole of the source when the cord is connected with the line, substantially as described.

5. In a telephone system, the combina-

tion with a telephone line, of a line relay with its coil normally in series with said line, a central source of current normally connected with said line through the coil of said line relay, a cut-off relay adapted by its actuation to remove said source from its connection with said line relay and to place a shunt about the coil thereof, whereby said line relay becomes deenergized, substantially as described.

6. In a telephone system, the combination with a telephone line, a central source of current, a line relay normally connecting said line with said central source, a single coil cut-off relay also associated with the line adapted by its actuation to shunt the coil of said line relay, whereby the latter may not be energized, substantially as described.

7. In a telephone system, the combination with a telephone line, of a line relay normally in series with the line, a cut-off relay having its coil connected between one of the limbs of the telephone line and a third conductor during conversation, said cut-off relay having contacts normally in series with the line relay and also having contacts adapted to complete a shunt about said line relay during conversation, whereby the line relay is deprived of actuating current, substantially as described.

8. In a telephone system, the combination with a telephone line, of a cut-off relay for the line, a source of current at the central office connected between the limbs of said telephone line by contacts of said cut-off relay, a line relay having its coil normally in series with the telephone line, a conductor permanently connected with the line at a point beyond the coil of said line relay and connecting with a normally open contact of said cut-off relay, said conductor being adapted to form a shunt circuit about the coil of said line relay when the cut-off relay is actuated, whereby the line relay will become deenergized, substantially as described.

9. In a telephone system, the combination with a telephone line, of a source of current at the central office normally connected with a limb of the line through contacts of the cut-off relay, a line relay in a limb of the line adapted to be shunted by the actuation of the cut-off relay, the actuation of said cut-off relay being also adapted to interrupt a normal connection between said source and said line, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 31st day of December 1903.

WILLIAM W. DEAN.

Witnesses:

E. A. GARLOCK,

ROBERT LEWIS AMES.