

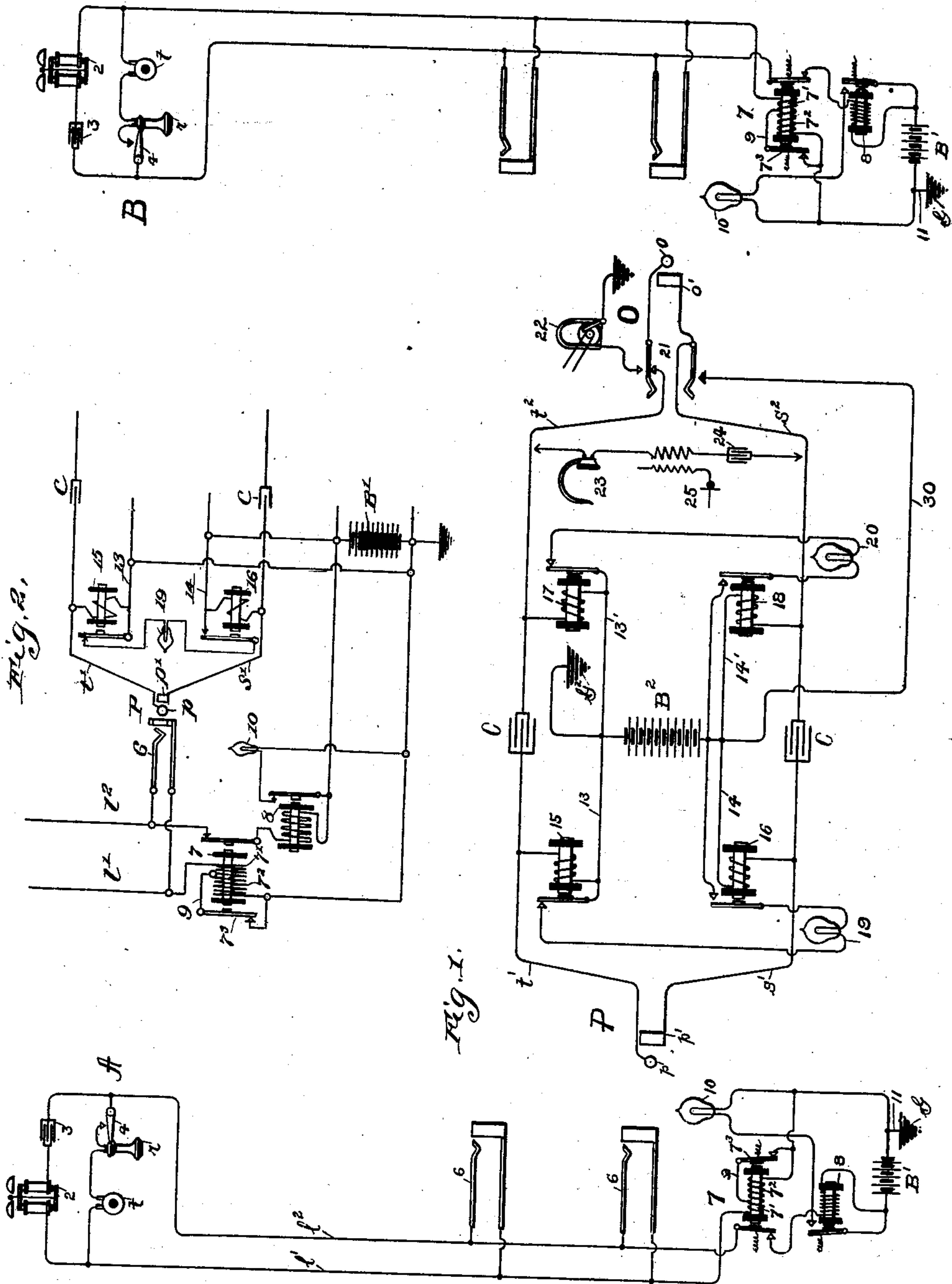
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PATENTED MAY 3, 1904.

W. W. DEAN.  
TELEPHONE SYSTEM.

APPLICATION FILED MAY 11, 1901. RENEWED SEPT. 24, 1903.

NO MODEL.



Witnesses.

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

**SPECIFICATION** forming part of Letters Patent No. 758,623, dated May 3, 1904.

Application filed May 11, 1901. Renewed September 24, 1903. Serial No. 174,521. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, and a 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, and has for its object the simplification of the apparatus, connections, and arrangements involved, as well as the provision of a rapid, efficient, and economical system.

It has been proposed to supply a telephone-line with a low-wound cut-off relay and a high-wound line-relay in the line-circuit, so that when the subscriber calls the central station sufficient current will not flow to operate the low-wound cut-off relay, but is ample to operate the high-resistance line-relay, and when the operator plugs in in response to the call additional current is sent through the low-wound relay to operate it to cut out the line-relay. In such an arrangement, however, a low-wound relay is connected between one side of the talking-circuit and ground or the office return, which might be said to be an objection, or the marginal difference of resistance between the line-relay and the cut-off relay is so small as to tend to cause trouble. In this system, therefore, I dispense with the low-resistance relay and insert instead a cut-off relay having two windings, one of said windings having, preferably, a low-resistance winding and the other preferably a high-resistance winding, the former being normally in the line-circuit, while the other is normally cut out or short-circuited and only thrown into the circuit when a connection is established with the line, as by the operator in connecting for conversational purposes, whereby instead of the low resistance in the grounded branch the full resistance of both coils of the relay or the high-wound coil is inserted.

The invention further consists of the novel constructions and arrangements hereinafter described, and particularly pointed out in the appended claims, reference being had to the accompanying drawings, forming a part here-

of, in which the same reference characters designate like parts throughout, and in which—

Figure 1 is a diagrammatic view of two subscribers' stations and the operator's connective circuit at the central station, and Fig. 2 is a like view showing but one battery.

In Fig. 1 the subscribers' stations A and B are provided with the usual apparatus, adapted, preferably, for use with a central source of current-supply and comprising a receiver  $r$  and transmitter  $t$  in a bridge of the line, that is normally open at switch-hook 4, and the bell 2 and condenser 3 in a permanent bridge of the line. The two limbs  $1'$  and  $1''$  of the subscriber's line extend to the central office, where they are connected with the multiple jacks 6 and with the battery  $B'$ , the line  $1''$  including one armature of the cut-off relay 7 and the magnet of the line-relay 8, while the other limb,  $1'$ , includes the windings of the cut-off relay 7 and is grounded at G. This relay has its winding divided, preferably, into a low-resistance portion  $7'$  of a few turns and the high-resistance portion  $7''$ , which is normally short-circuited through the armature  $7^3$  of said relay and branch 9. The line-relay 8 is adapted to close a local circuit through its armature and forward contact-anvil, including the individual-line lamp 10 and battery  $B'$ . A ground branch 11 is provided between battery  $B'$  and the cut-off relay 7.

The operator's connective apparatus comprises the answering and calling plugs P and O, the former having a tip-strand  $t'$  and a sleeve-strand  $s'$ , connected with its corresponding contacts and which are connected, by means of branch conductors 13 and 14 through the supervisory relays 15 and 16, to the central battery  $B''$ . The calling-plug O has its tip and sleeve strands  $t''$  and  $s''$  connected, respectively, with the similar supervisory relays 17 and 18 in conductors 13' and 14', which said supervisory relays are adapted to control, through the medium of their armatures and contacts, the supervisory lamps 19 and 20, associated, respectively, with the answering and calling plugs. The condensers  $c$  are interposed in the tip and sleeve strands to induce



tively join the two portions of the cord-circuit for the free passage of the voice-currents. The ringing-key 21 is connected with the calling-plug O, and when the operator rings a subscriber it is adapted to connect the calling-generator 22 therewith. The operator's telephone 23 is bridged across the cord-circuit, as shown, and includes in its circuit the condenser 24 and secondary of the induction-coil. The operator's transmitter 25 is preferably charged from source B<sup>2</sup>.

In the operation of the system the calling subscriber takes up his receiver, thus closing the line-circuit by means of his hook-switch, and operates the line-relay 8 over the two limbs 1' and 1<sup>2</sup> of his line from the battery B', said circuit also containing the low-resistance winding of the cut-off relay, the other winding, 7<sup>2</sup>, thereof being short-circuited. This low-resistance winding 7' does not receive current enough over this circuit to cause it to attract its armatures, and only the line-relay is operated to light the individual lamp 10. The operator upon observing the signal inserts the answering-plug P into the subscriber's jack and by so doing closes a local circuit, which may be traced from ground G<sup>2</sup> at the cord-circuit through the battery B<sup>2</sup>, conductor 14, supervisory relay 16, sleeve-strand s' of the answering-plug P, the test-ring of the subscriber's jack, and a portion of the limb 1' of the subscriber's line, the low-resistance winding 7' of the cut-off relay, and the short-circuiting branch 9 to ground G. The closing of this circuit operates the supervisory relay 16 and cut-off relay 7 and causes the latter to open the limb 1<sup>2</sup> of the telephone-line, thereby rendering the line-relay inoperative and retiring the line-signal 10. At the same time armature 7<sup>3</sup> is attracted to open the short circuit 9 about the high-resistance coil 7<sup>2</sup>, which coil is then inserted in said local circuit in series with coil 7' of low resistance. The current flowing, however, is sufficient to maintain the same operated, while the ground or common return branch is thus completed through a path of high resistance and high impedance. Upon learning the number of the party wanted the operator tests the subscriber's line in the usual way, and upon finding it idle inserts the calling-plug O and operates the key 21 to ring the subscriber's bell. The insertion of this plug operates cut-off relay 7, as just described, for the calling-line and line-signal 10 is prevented from glowing. The ringing-circuit is from ground at the generator to the subscriber's station and back and over the conductor 30 through the battery B<sup>2</sup> to ground G<sup>2</sup>. The continued presence of the battery upon the line when ringing prevents the deenergization of cut-off relay 7, and the use of the branch 30 prevents rattling of the supervisory relay 18. When answering-plug P was first inserted, the supervisory relay 16 operated, as stated, to close the circuit of lamp

19 through the armature and front contact, while the supervisory relay 15, which is under the control of the subscriber, was operated over the metallic line and the tip and sleeve strands of the cord-circuit to battery B<sup>2</sup>. This served to render the supervisory lamp 19 inert; but upon the insertion of the plug O the supervisory relay 17, connected with the tip-strand t<sup>2</sup>, was not operated to open the circuit of the supervisory lamp 20. This lamp, therefore, is lighted and remains so until the called subscriber responds, when relay 17 is operated to extinguish the lamp 20. The subscribers are now connected for conversation. Under these conditions the ground or common return branch from one side of each subscriber's line exists; but each includes both windings or the high-resistance winding of the cut-off relay 7 and is therefore impervious to speech-waves and does not hinder or affect the conversation over the metallic line. When the subscribers return their receivers to the telephone-hooks, the relays 15 and 17 in the cord-circuit are deenergized and close the circuit of the lamps 19 and 20 to indicate to the operator that the conversation is terminated and the connection may be pulled down and all parts restored to normal condition.

In testing the tip of the calling-plug is merely touched against the test-rings of the jack. If a connection exists with the line, the test-rings are connected to the live side of the battery and a click is received in the operator's telephone. If the subscriber has just called, the test-rings are connected through line-conductor l', the substation instruments, and the other line-conductor, l<sup>2</sup>, with the live pole of the line-battery, whereby a test-click can be received as soon as the subscriber takes up his receiver, and there is no danger of his line being connected with at a multiple section before the answering operator answers his call.

It will be understood that the several grounds mentioned are or may be the office return and also that the batteries mentioned may be one and the same. The latter feature is shown in Fig. 2, wherein the same reference-characters are used as before and in which the cord-circuit strands are connected directly with the battery B', the operation being the same as before described with reference to Fig. 1.

Although line-relay is spoken of herein, I consider any electromagnetic signaling device an equivalent.

While I have described the invention with particular reference to the details of the construction and arrangement, I would have it understood that the invention is not limited thereto, as many and various changes may be made therein and still come within its scope and principle; but

What I desire to claim by Letters Patent is—



1. In a telephone system, the combination with a telephone-line circuit, of a line-signal-controlling electromagnet and a source of current in the line-circuit, a cut-off relay having  
5 a high-resistance winding and a low-resistance winding, said low-resistance winding being normally connected with the line, and means to operate said cut-off relay to cut into circuit the high-resistance winding.
- 10 2. In a telephone system, the combination with a line-circuit, of a cut-off relay having two windings, a line-signal-controlling electromagnet and a battery all included in series in said line-circuit, and means to operate the  
15 cut-off relay to render the said electromagnet inoperative.
3. In a telephone system, the combination with a line-circuit, of a line-signal-controlling electromagnet, a source of current and a cut-  
20 off relay in said circuit, said cut-off relay having two windings and adapted when operated to open the circuit of said electromagnet.
4. In a telephone system, the combination with a line-circuit, of a cut-off relay having  
25 two windings, means for shunting one of said windings, a line-signal-controlling electromagnet and a battery, said relay, electromagnet and battery being in series in said line-circuit, and means to operate the cut-off relay  
30 to render the said electromagnet inoperative, substantially as described.
5. In a telephone system the combination with a telephone-line circuit, of a cut-off relay having a high-resistance winding and a low-  
35 resistance winding, said low-resistance winding being normally connected with the line and the high-resistance winding normally cut out of the line, a line-signal-controlling electromagnet and a source of current also in said  
40 line, and means for cutting said high-resistance winding into the circuit when the cut-off relay is operated.
6. In a telephone system, the combination with a telephone-line, of a line-signal-controlling electromagnet and a source of current in  
45 the line-circuit, a cut-off relay having a high-resistance and a low-resistance winding, said low-resistance winding being normally connected with the line, and means to operate said  
50 cut-off relay to cut out the said electromagnet and cut in the high-resistance winding.
7. In a telephone system, the combination with a telephone-line circuit, of a line-signal-controlling electromagnet and a source of current in said circuit, a cut-off relay having a  
55 portion only of its winding normally in the line-circuit, and means to operate said cut-off relay to render the said electromagnet inoperative and to cut in the remaining portion of  
60 the cut-off-relay winding.
8. In a telephone system, the combination with a telephone-line circuit, of a line-signal-controlling electromagnet and a source of current in said circuit, a cut-off relay having two  
65 windings, only one of which is normally in

said circuit, and means for operating said cut-off relay to render the said electromagnet inoperative and to cut the other winding into the circuit.

9. In a telephone system, the combination 70 with a telephone-line circuit, of a line-signal-controlling electromagnet and a source of current in the telephone-circuit, a cut-off relay having a high-resistance and a low-resistance winding in said circuit, the high-resistance 75 winding being normally shunted, and means to operate the cut-off relay to cut out the said electromagnet and break the shunt about the high-resistance winding.

10. In a telephone system, the combination 80 with a line-circuit, of a line-signal-controlling electromagnet and a source of current in said circuit, a cut-off relay having a low-resistance winding and a high-resistance winding, the low-resistance winding being normally in the 85 circuit and the high-resistance winding being normally out of the circuit, a cord-circuit, and means actuated in connecting the cord-circuit with the line to operate the cut-off relay to cut out the said electromagnet and to cut in the 90 high-resistance winding of the cut-off relay.

11. In a telephone system, the combination with a line-circuit, of a line-signal-controlling electromagnet and a source of current in said circuit, a cut-off relay having a high-resistance 95 winding and a low-resistance winding, and an armature of said relay to short-circuit its high-resistance winding.

12. In a telephone system, the combination with a line-circuit, of a line-signal-controlling 100 electromagnet and a source of current in said circuit, a cut-off relay having two sets of switch-contacts, one of said sets being adapted to normally short-circuit a portion of the cut-off-relay winding and the other to com- 105 plete the line-circuit through the said electromagnet.

13. In a telephone system, the combination with a line-circuit, of a line-signal-controlling electromagnet and a source of current in said 110 circuit, a cut-off relay having a low-resistance and a high-resistance winding and two sets of switch-contacts, the high-resistance winding being normally short-circuited or shunted through one of said sets, and means to operate 115 the cut-off relay in the act of making a connection with the line to cut out the said electromagnet and open the short circuit or shunt about the high-resistance winding.

14. The combination with a telephone-line, 120 of a line-signaling device and a source of current in the line, a cut-off relay for the line having two windings, one of said windings being normally short-circuited, and means to pass current through the other winding to op- 125 erate the relay to open the short circuit about its first-named winding and to render the signaling device inoperative, substantially as described.

15. The combination with a telephone-line, 130



of a line-signaling device, a source of current in the line, a cut-off relay having a high-resistance and a low-resistance winding, the high-resistance winding being normally short-circuited, and means to pass current through the low-resistance winding to initially operate the relay to open the short circuit about its first-named winding and to render the signaling device inoperative, substantially as described.

16. The combination with a telephone-line, of a line-signaling device and a source of current in the line, a cut-off relay for the line having a low-resistance and a high-resistance winding, the high-resistance winding being normally shunted, and means to close the low-resistance winding in a local circuit to operate the same to open the shunt of the high-resistance winding and to render the signal inoperative, substantially as described.

17. The combination with a telephone-line, of a line-signaling device, a cut-off relay and a battery in the line, said cut-off relay having a low-resistance and a high-resistance winding, the latter being normally shunted, a jack for the line, a cord-circuit, a branch from each strand of said circuit to the opposite poles of the battery, a supervisory relay in the path of current over each branch, a supervisory signal controlled by said relays, whereby when a connection is established with the line, the low-resistance winding of the cut-off relay is closed in a local circuit and is thereby operated to break the shunt about its high-resistance winding and to open the circuit of the signaling device, one supervisory relay being included in said local circuit to place the supervisory signal in condition to operate, and the other supervisory relay being included in a circuit including the telephone-line and serving when actuated to prevent the operation of said supervisory signal, the said battery also serving to furnish current for talking purposes, substantially as described.

18. The combination with a telephone-line, of a signal-controlling electromagnet and battery in the line, a cut-off relay having two windings, said relay being in the path of current in the line when the subscriber is calling the central office but unresponsive thereto, and means for operating said relay to render said magnet inoperative, substantially as described.

19. The combination with a telephone-line, of a signal-controlling electromagnet and battery in the line, a cut-off relay having two windings, said relay being in the path of current in the line when the subscriber is calling the central office but unresponsive thereto, and means for operating said relay when a connection is established with the line to operate said cut-off relay and thereby render said magnet inoperative, substantially as described.

20. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay in

series in the line and having two windings, said relay being unresponsive to current in the line when the subscriber is calling the central office, and means for including one of said windings in a local circuit with a source of current when a connection is made with the line to operate said relay and thereby render said magnet inoperative, said local-current source also furnishing current for talking, substantially as described.

21. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay in series in the line and having two windings, said relay being unresponsive to current in the line when the subscriber is calling the central office, an operator's cord-circuit, and a local circuit containing one winding of said relay adapted to be closed when the operator's circuit is connected with the line to operate said relay and render said magnet inoperative, substantially as described.

22. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay in series in the line and having two windings, said relay being unresponsive to current in the line when the subscriber is calling the central office, a jack for the line, an operator's circuit and connecting-plug, and a local circuit including one winding of said relay adapted to be closed through registering contacts of the jack and plug upon the insertion of the plug into the jack in making a connection with the line, whereby said relay is operated to render the said magnet inoperative, substantially as described.

23. The combination with a telephone-line, of a signal-controlling electromagnet, a source of current and a cut-off relay all in series in the line, said relay having two windings and being unresponsive to current in the line when the subscriber is calling the central office, the limb of said line in which the said magnet is placed being normally completed through switch-contacts of said relay, and means for operating said relay to open said contacts when the line is switched for use, substantially as described.

24. The combination with a telephone-line, of a signal-controlling electromagnet, a source of current and a cut-off relay all in series in the line, said relay having two windings and being unresponsive to current in the line when the subscriber is calling the central office, the limb of said line in which the said magnet is placed being normally completed through switch-contacts of said relay, and means for directing an operative current through a winding of said relay when a connection is established with the line, whereby to operate the same to open said limb and cut out said magnet, substantially as described.

25. The combination with a telephone-line, of a signal-controlling magnet and a source of



current in the line, a cut-off relay in series in the line having two windings and adapted when operated to render said magnet inoperative, and means to send current through both said windings under some condition of use and through one winding only under other conditions of use, substantially as described.

26. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in series in the line, a cut-off relay, one winding of said relay being permanently in the path of current flowing in the line, a second winding for said relay, said relay being inoperative to current in the line when a subscriber is calling the central office, and a local circuit established through said permanently-connected winding when a connection is made with the line to direct an operative current therethrough, substantially as described.

27. The combination with a telephone-line, of a signal-controlling electromagnet, and a source of current in series in the line, a cut-off relay, one winding of said relay being permanently in the path of current flowing in the line, a second winding for said relay, said relay being inoperative to current in the line when a subscriber is calling the central office, and means for sending an operating-current through said first-mentioned winding as long as the line is switched for use, substantially as described.

28. The combination with a telephone-line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay in series in the line and having two windings, said relay being unresponsive to current in the line when the subscriber is calling the central office, and means for sending an operating-current through one of said windings over a circuit composed in part of a portion of the talking-circuit, substantially as described.

29. The combination with a telephone-line, of a signal-controlling electromagnet, a source of current and a cut-off relay all in series in the line, said relay having two windings and being unresponsive to current in the line when the subscriber is calling the central office, the limb of said line in which the said magnet is placed being normally completed through switch-contacts of said relay, and a circuit closed in registering contacts of the plug and jack for sending an operating-current through one of said windings, said circuit being composed in part of a portion of the talking-circuit, substantially as described.

30. The combination with a telephone-line, of a signal-controlling electromagnet, and a source of current in series in the line, a cut-off relay, one winding of said relay being permanently in the path of current flowing in the line, a second winding for said relay, said relay being inoperative to current in the line when a subscriber is calling the central office, and means for sending an operating-current

through said first winding as long as the line is switched for use and over a circuit composed in part of a portion of the talking-circuit, substantially as described.

31. In a telephone system, the combination with a subscriber's line having conductors normally extending to opposite poles of a source of current, of a signal-controlling electromagnet in one of said conductors, a switch in said conductor, and a cut-off relay having two windings, the actuating-winding thereof being connected in the other conductor of said line and controlling said switch, substantially as described.

32. In a telephone system, the combination with a subscriber's line having conductors extending to opposite poles of a source of current, of a signal-controlling electromagnet in one of said conductors, a cut-off relay having two windings, the actuating-winding thereof being in the other conductor, said relay serving to control the continuity of the first-named conductor, and means to send an operative current through said actuating-winding of said relay to cause it to open the opposite conductor when a connection is established with the line, substantially as described.

33. In a telephone system, the combination with a subscriber's line normally extending to opposite poles of a source of current, of a signal-controlling electromagnet in one of said conductors, and a cut-off relay having two windings and controlling the continuity of the first-named conductor, said relay having its actuating-winding connected in said opposite conductor, said winding being energized over a portion of the talking-circuit when a connection is established with the line to render the signal-controlling electromagnet inoperative, substantially as described.

34. The combination with a telephone-line, of a line-signal and a cut-off relay having two windings and a source of current normally in circuit in the said line, the cut-off relay being unresponsive to current from said source when the subscriber is calling, a cord-circuit adapted to be connected with the line, a supervisory signal associated therewith, means for operating said signal over a local circuit including a portion of the talking-circuit when said cord-circuit is connected with the line, and means controlled by the subscriber for rendering said signal inoperative by current passing over the line-circuit, substantially as described.

35. In a telephone system, the combination with a telephone-line, of a line-signal and a source of current in the line-circuit, a cut-off relay having a high-resistance winding and a low-resistance winding, said low-resistance winding being normally connected in the line in the path of current when the subscriber is calling the central office, connection-terminals for the line permanently connected therewith, a cord-circuit to establish a connection



with the connection-terminals, and means to operate said cut-off relay to cut into circuit the high-resistance winding of the same when the cord-circuit is connected with one of the  
5 connection-terminals, substantially as described.

36. The combination with a telephone-line, of a plurality of connection-terminals therefor permanently connected with the line, a  
10 cut-off relay and a battery in the line, said cut-off relay having a low-resistance winding and a high-resistance winding, the latter being normally shunted, a cord-circuit, a branch from each strand of said circuit to the opposite poles of the battery, whereby when a connection is established with the line the low-resistance winding of the cut-off relay is closed in a local circuit and is thereby operated to break the shunt about its high-resistance  
20 winding and to render the signaling device inoperative, and a supervisory signal associated with the cord-circuit and adapted to be placed in condition to operate by the current in said local circuit and rendered inoperative by current from said source over the telephone-line when the subscriber's telephone is in use, said source also serving to furnish current for talking purposes, substantially as described.

37. The combination with a telephone-line,  
30 of a signal-controlling electromagnet and a source of current in the line, a cut-off relay

having two windings, said relay being in the path of current in the line when the subscriber is calling the central office but unresponsive thereto, a jack for the line permanently connected therewith, and a local circuit including one winding of said relay adapted to be closed through registering contacts of the jack and plug upon insertion of the plug into the jack in making a connection with the line, whereby said relay is operated to render said magnet inoperative, substantially as described. 35 40

38. The combination with a telephone-line, of a plurality of connecting-jacks permanently connected with the line, a cut-off relay in series in the line and having two windings, said relay being unresponsive to current in the line when the subscriber is calling the central office, a battery to furnish current for talking, and means for sending an operating-current  
50 from said battery through one of said windings over a circuit composed in part of a portion of the talking-circuit when connection is established with one of said permanently-connected jacks, substantially as described. 55

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

WILLIAM W. DEAN.

Witnesses:

KEMPSTER B. MILLER,  
LEROY D. KELLOGG.