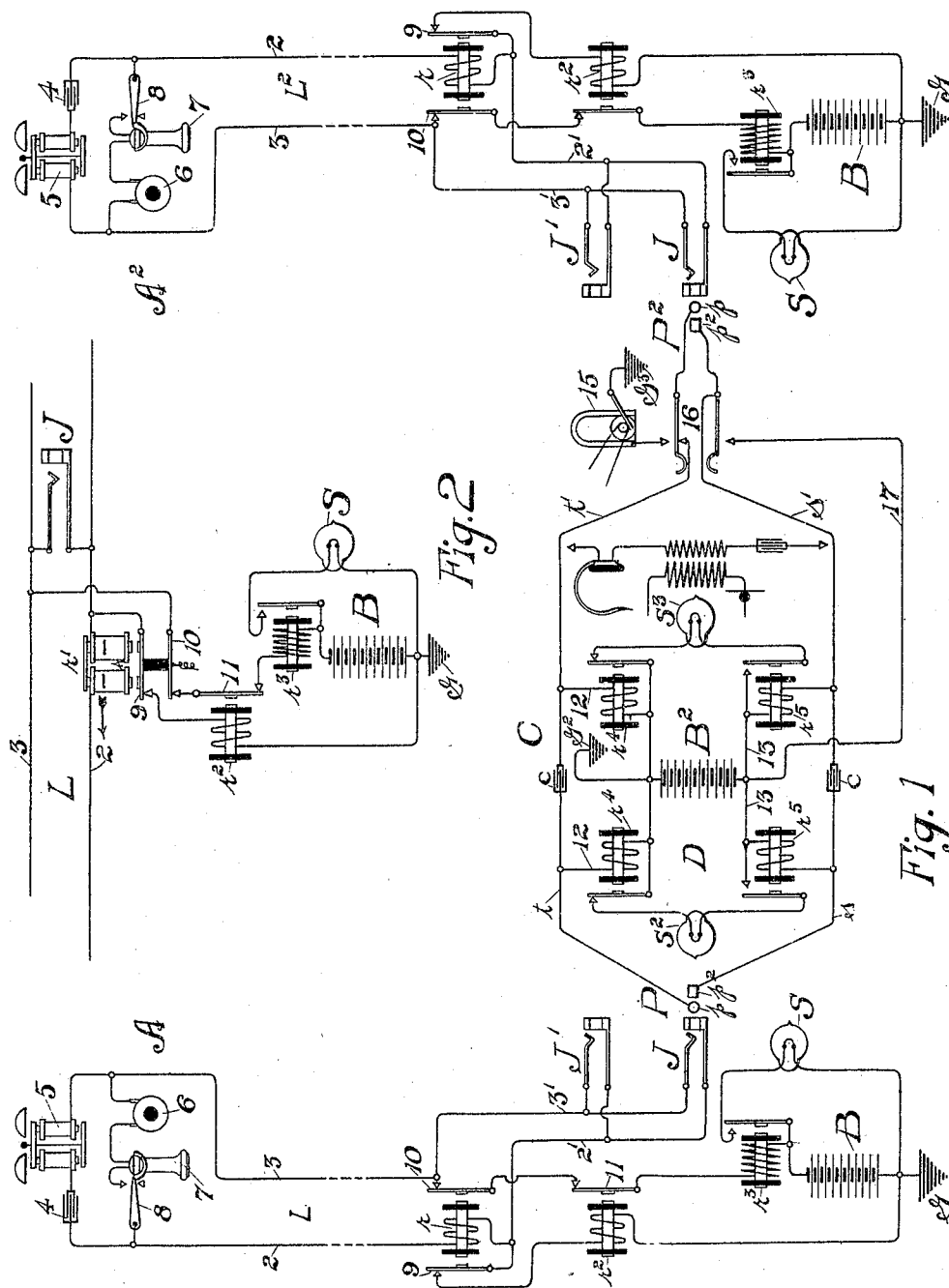


W. W. DEAN.
TELEPHONE SYSTEM.
APPLICATION FILED MAY 27, 1901.



Witnesses.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 794,702, dated July 11, 1905.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, 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 wherein subscribers' lines center at one or more offices and wherein means are provided to variously connect the lines together for conversational purposes. It has special reference to those systems employing central batteries for automatically signaling from subscribers' stations to the central office and for the operation of supervisory signals associated with established connections. It has for its object, generally stated, the provision of a system having few and simple parts and one that will be positive, efficient, and economical in operation.

In the carrying out of my invention I provide the subscribers' lines with a plurality of cut-off relays, which are insensitive or irresponsible to calling current in the line, but which are adapted to be operated at desired times to render the line-signals inoperative, and finally to produce a conversational circuit having no ground branches or similar obstructions connected therewith.

The invention therefore consists in 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 hereof, in which the same reference characters designate like parts throughout both views, in which—

Figure 1 represents diagrammatically two subscribers' stations and a central-office connective apparatus, and Fig. 2 is a modification in diagram of the arrangement of the cut-off relays in the subscriber's line.

L and L² represent subscribers' lines extending, respectively, from the subscribers' stations A and A² to the central office C. At the subscribers' stations the line conductors 2 and 3 are connected together by a perma-

nent branch conductor, including in series the condenser 4 and the standard signal-bell 5, the transmitter 6 and receiver 7 being in a bridge of the circuit, which is normally opened by the telephone-hook 8 and closed when the receiver is removed therefrom.

At the central office the line conductor 2 includes a cut-off relay *r*, provided with two armatures or a double armature, the said line being extended on through one of the armatures 9 and through another cut-off relay *r*² to ground at G. The other line conductor 3 passes through the other armature 10 of the cut-off relay *r*, thence through the armature 11 of the cut-off relay *r*², through the line-relay *r*³, battery B, and is connected with the other line conductor 2. These relays *r* and *r*² are insensitive or unresponsive to calling-current in the line, while the line-relay *r*³ is sensitive or responsive to such currents, whereby when the subscriber closes his line-circuit by taking up his receiver only the line-relay *r*³ is operated. This difference of sensitiveness or responsiveness may be obtained in many different ways, that shown in Fig. 1 consisting of low-wound cut-off relays of few turns and a high-wound line-relay of a greater number of turns, the attending result that sufficient current does not flow in the line to operate the low-resistance relays when a subscriber calls, thus leaving the line intact, while the line-relay is energized to expose its signal. Each of the lines is provided with an individual signal-lamp S, the circuit of which is completed from the battery B by the line-relay *r*³ when a subscriber calls. The subscribers' lines are also provided with jacks or switch-sockets J and J', having tip and sleeve contacts connected with the branches 3' and 2', the cut-off relay *r* being in the line-circuit between the subscriber's station and the jacks.

A cord-circuit D is provided at the central office and includes the connecting-plugs P P², which have tip and sleeve contacts *p* *p*², the tip-strand *t* and sleeve-strand *s* being connected with the corresponding contacts of the answering-plug P and the similar strands *t'* and *s'* with the tip and sleeve contacts of the

calling-plug P^2 . The condensers c serve to divide the two strands conductively and to unite them inductively for the free passage of voice-currents. The strands t and t' are connected with one pole of the battery B^2 , which is grounded at G^2 , through the medium of branch conductors 12, which include supervisory relays r^4 , while the sleeve-strands s and s' are in like manner connected with the other pole of the same battery through corresponding branches 13, similar supervisory relays r^5 being included in said branches 13. Supervisory lamps S^2 and S^3 have their circuits from the battery B^2 controlled by these relays r^4 and r^5 , the former normally closing the circuits, while the latter normally open them and are associated, respectively, with the answering and calling plugs P and P^2 .

The operator's telephone is adapted to be bridged across the cord-circuit, as indicated diagrammatically, the bridge including her receiver, the condenser, and the induction-coil in series, while the transmitter and primary of the induction-coil are in a local circuit. (Not completely shown, but preferably containing the battery B^2 .) A ringing-generator 15, having one pole grounded, is adapted to be connected with the calling-plug P^2 by the ringing-key 16 to enable the operator to signal the subscriber.

In the operation of the system the subscriber closes his line-circuit by removing the receiver from the telephone-hook, which allows current from the battery B connected with that line to flow throughout the metallic line, including the coils of the cut-off relays r and r^2 and the line-relay r^3 . As before stated, on account of the small flow of current at this time only the sensitive relay r^3 is operated to close the circuit of the individual signal-lamp S . The operator observing the lighted lamp inserts the answering-plug P into the jack J and by so doing closes a local circuit from ground G^2 at the cord-circuit, through the battery B^2 , the branch conductor 13, connected with the sleeve-strand s , the supervisory relay r^5 , sleeve-strand s , sleeve-contacts of the plug P and jack J , the branch conductor 2' forming part of the talking-circuit, armature 9 of cut-off relay r , relay r^2 to ground at G . Owing to the fact that the subscriber's telephone is now off the hook, a second path for the current from battery B^2 is now also provided from the junction of the ground branch containing armature 9 with the line conductor 2, over said line conductor 2 to the substation, with return over conductor 3, the current in this latter path being obviously in the reverse direction from that which flows therein when the subscriber is calling the central office. As a result of the establishment of these various circuits and connections by the act of plugging-in in response to the subscriber's call, the cut-off relay r is operated and attracts both its armatures to entirely cut

off the relays r^2 and r^3 and the ground connection and to retire the signal S . The insertion of the plug P also energizes the supervisory relays r^4 and r^5 , the one to open and the other to close the circuit of the supervisory signal S^2 , which therefore remains inert.

Upon ascertaining the party wanted the line is tested and if idle the calling-plug P^2 is inserted in the jack of that subscriber and the ringing-key 16 operated to throw the generator 15 into connection with the subscriber's line. The circuit for the ringing-current may be traced from ground at G^3 at the generator, through the plug P^2 , over the line L^2 to the subscriber's station A^2 , and back to the central office, where it passes through the sleeve of the plug to the branch conductor 17, through the battery B^2 to ground at G^2 . The branch 17 is in parallel with the sleeve-strand s' for the purpose of providing a by-path for ringing-current about the relay r^5 to prevent possible chattering of the same. Before the subscriber responds a local circuit is established from the ground G^2 at the cord-circuit through the battery B^2 , the supervisory relay r^5 , and sleeve-strand s' , through the portion 2' of the talking-circuit, the armature 9 of cut-off relay r , which has not yet been energized, through the relay r^2 to ground G . This operates the cut-off relay r^2 to cut out the line-relay r^3 to cause line-lamp S to remain inert and to close the circuit of the supervisory lamp S^3 , which is now illuminated and remains so until the response of the called subscriber, when the relay r^4 in the metallic circuit is operated to open the supervisory-lamp circuit and extinguish the same to indicate the response to the operator, and relay r is energized to cut off the line extension and ground. It will be observed that the relays r^4 , and therefore the lamps S^2 and S^3 , are under the control of the respective subscribers, since as soon as the metallic line is opened at the hook-switches the relays r are deenergized; but the local circuits through r^2 are immediately established and relays r^5 remain excited to prevent the undesired opening of the supervisory-lamp circuits and the lighting of line-lamps S . The relays r^5 are therefore deenergized only when the plugs are withdrawn and then serve to open the supervisory-lamp circuits. The subscriber is enabled before disconnection to wink his supervisory lamp by vibrating his hook to attract the operator's attention. Had the called subscriber's line been busy when the operator tested the same the sleeve of the jacks would have been connected with the live side of the battery and a complete circuit would have been established from the sleeve of the jack through the tip of the calling-plug to ground G^2 or the office return. This would have caused a click in the operator's receiver and would have indicated to her the condition of the line. It will also be observed that when

the subscriber first calls for a connection the sleeve-terminals of the jacks, which are the testing-terminals, are connected with the live pole of the battery B through the telephone-line conductor 3, the subscriber's instrument, and the line-limb 2 and conductor 2', and since the cut-off relay r^2 is possessed of an appreciable resistance a test-click is received by the operator over her grounded tip-cord strand when she tests a line under these conditions.

When the subscribers are through talking, their receivers are returned to the telephone-hooks and the lines opened, thus deenergizing the supervisory relays r^4 and allowing their armatures to close the circuits of the supervisory signals S^2 and S^3 , which are lighted and indicate to the operator the termination of the conversation. The plugs are then withdrawn and all parts restored to normal condition, the relays r^5 serving to open the circuits of lamps S^2 and S^3 .

While I prefer to render the cut-off relays insensitive to current in the line when a subscriber is calling by making them of low resistance and of few turns and to render the line-relay sensitive to such currents by making it of high resistance and a greater number of turns, I do not limit myself to this specific construction and arrangement. Other methods for accomplishing the same results may be employed. For example, in Fig. 2 a polarized cut-off relay r' is shown which may be used in place of the relay r of Fig. 1 and which will not operate when the subscriber calls by reason of the wrong direction of current there-through from the battery B, but which relay will operate as soon as a subscriber inserts a plug of the cord-circuit similar to that of Fig. 1 into the jack J of the line, for current will then be reversed through it.

It will be understood that the line-relays and lamps may be replaced by other signaling devices, that the several batteries referred to may be one common source of current, preferably a storage battery, and that the several grounds mentioned may be the usual office return. A through metallic talking-circuit from one station to the other entirely free from grounds is thus provided. I have secured good results with cut-off relays r of twenty ohms resistance, relays r^2 of one hundred ohms resistance, and the line-relays of one thousand ohms, the other parts being of the dimensions usually or preferably employed.

Having described my invention, what I claim is—

1. In a telephone system, the combination with a subscriber's line-circuit, of two cut-off relays for the line, a line-relay, a line-signal controlled thereby, a source of current, and means for operating one or the other of said cut-off relays under different conditions of use for rendering the line-signal inoperative, substantially as described.

2. In a telephone system, the combination

with a telephone-line; of two cut-off magnets, a line signaling-magnet and a central source of current in series in the line; said cut-off magnets being unresponsive to current in the line when the subscriber is calling the central office and the line signaling-magnet responsive, and means for operating one or the other of said cut-off magnets under different conditions of use and over circuits including a portion of the talking-circuit to render the line-signal inoperative, substantially as described.

3. In a telephone system, the combination with a telephone-line; of two low-resistance cut-off magnets, a high-resistance line-signal-controlling magnet and a central source of current in series in the line; said cut-off magnets being unresponsive to current in the line when the subscriber is calling the central office and said signal-controlling magnet being responsive to such current, and means for operating one or the other of said cut-off magnets under different conditions of use to render the line-signal inoperative, substantially as described.

4. In a telephone system, the combination with a subscriber's line-circuit, of two cut-off relays in the circuit, a line-relay, a line-signal, a source of current, the cut-off relays being insensitive and the line-relay sensitive to calling-current in the line, means for operating one of said relays at one time and the other at another time, and further means controlled by either of said relays when operated to render the line-signal inoperative, substantially as described.

5. In a telephone system, the combination with a subscriber's line-circuit, of two electromagnetic cut-off devices for the circuit, a line signaling device, a source of current, and means to operate one of said cut-off devices in the act of establishing a connection with the line and for operating the other when the subscriber responds, substantially as described.

6. In a telephone system, the combination with a subscriber's line-signal; of two cut-off magnets, a line-signal magnet and a central source of current in the circuit; said cut-off magnets being unresponsive to current in the line when the subscriber is calling the central office and the line-magnet being responsive, and means to operate one of said cut-off magnets in the act of establishing a connection with the line, and for operating the other when the subscriber responds, substantially as described.

7. In a telephone system, the combination with a subscriber's line-circuit; of two low-resistance cut-off magnets, a high-resistance line-signal-controlling magnet, and a central source of current in series in said circuit whereby when the subscriber is calling only the line-signal magnet is operated; and means to operate one of said cut-off magnets in the act of establishing a connection with the line and for operating the other when the subscriber responds, the circuit of both said magnets in-

cluding a portion of the talking-circuit, substantially as described.

8. In a telephone system, the combination with a subscriber's line-circuit, of two cut-off relays in the circuit, a line-relay, a line-signal, a source of current, said cut-off relays being insensitive and the line-relay sensitive to calling-current in the line, and means to operate one of said insensitive relays over a circuit having a portion coincident with the talking-circuit to render the line-signal inoperative when a connection is established with the line and the line-circuit is open at the subscriber's station, and for operating the other insensitive relay to cut out both of the other relays when the subscriber responds, substantially as described.

9. In a telephone system, the combination with a subscriber's line-circuit, of two cut-off relays in the circuit, a line-relay, a source of current, said cut-off relays being insensitive and the line-relay sensitive to calling-current in the line, a grounded circuit completed in the act of making a connection with the line for operating one of the cut-off relays to cut out the line-relay, and means for operating the other cut-off relay over the talking-circuit to cut out both of the other relays and the ground connection, substantially as described.

10. In a telephone system, the combination with a subscriber's line-circuit; of two cut-off relays, a line-signal-controlling magnet and a central source of current in the circuit; said cut-off relays being of low resistance and the line-signal-controlling magnet of high resistance, whereby the latter only operates when the subscriber is calling the central office, a grounded circuit completed in the act of making a connection with the line for operating one of the cut-off relays to prevent the operation of the line-signal, and means for operating the other cut-off relay over the line talking-circuit during conversation to cut off the other relay and the signal-controlling electromagnet, substantially as described.

11. In a telephone system, the combination with a subscriber's line-circuit, of two cut-off relays for the line, a line signaling device for the line, and a source of current, one of said cut-off relays being operated when a connection is established with the line and the other cut-off relay being operated during conversation, said relays serving when actuated to render the line-signal inoperative, substantially as described.

12. In a telephone system, the combination with a subscriber's telephone-line, of two cut-off relays for the line, a line signaling device for the line, a source of current associated with the line, and means for operating one of said cut-off relays when a connection is established with the called subscriber's line to render the said device inoperative and for operating the other cut-off relay when the subscriber responds to cut off all ground connections

from the line talking-circuit, substantially as described.

13. In a telephone system, the combination with a subscriber's telephone-line; of two cut-off relays, a line-signal-controlling magnet and a central source of current in the line whereby when the subscriber calls only the line-signal is operated; and means for operating one of said cut-off relays when a connection is established with the called subscriber's line to render the line-signal inoperative, and for operating the other cut-off relay when the subscriber responds to cut off all ground connections from the talking-circuit of the telephone-line, substantially as described.

14. In a telephone system, the combination with a subscriber's telephone-line; of two low-resistance cut-off relays, a line-signal-controlling electromagnet of high resistance and a central source of current in series in the line, whereby when the subscriber calls only the signaling-magnet is operated; and means for operating one of said cut-off relays when a connection is established with the called subscriber's line to render the signal inoperative, and for operating the other cut-off relay when the subscriber responds to cut off all ground connections from the talking-circuit of the line, substantially as described.

15. In a telephone system, the combination with a subscriber's telephone-line, of two electromagnetic cut-off devices for the line, a line signaling device for the line, a source of current associated with the line, and means for operating one of said cut-off devices when a connection is established with the line and for operating the other of said cut-off devices during conversation, the operation of the first cut-off device serving to render the line signaling device inoperative and the operation of the second cut-off device serving to entirely disconnect the line signaling device and the first cut-off device from the line, substantially as described.

16. In a telephone system, the combination with a telephone-line; of two low-resistance cut-off magnets, a high-resistance line-signal-controlling electromagnet and a central source of current in the line, whereby when a subscriber calls only the line-signal is operated; and means for operating one of said cut-off devices when a connection is established with the line, and for operating the other of said cut-off devices during conversation, the operation of the first-named cut-off device serving to render the line-signal inoperative, and the operation of the second cut-off device serving to entirely disconnect said first cut-off device and signal-controlling magnet from the talking-circuit of the line, substantially as described.

17. 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 elec-

tromagnet in one of said conductors, a switch in said conductor between said magnet and the subscriber's station, a pair of cut-off relays each having a winding connected in the line, the actuating-winding of one of said relays being connected in the other conductor of said line, said relays being unresponsive to current in the line when the subscriber is calling the central station, and said second-named relay serving to control the said switch, substantially as described.

18. The combination with a telephone-line, of a line signaling device, a pair of cut-off relays and a source of current normally in circuit in the line, the line signaling device only being responsive to current from said source when a subscriber is calling, a cord-circuit adapted to be connected with the line, a supervisory signal associated therewith, means for establishing a path for current over one side of the said cord-circuit to operate one of said relays and to place said supervisory signal in condition to operate, and a relay adapted to render the said signal inoperative and having its windings disposed in a path of current over the other side of the cord-circuit and the telephone-line, the other cut-off relay being also included in the telephone-line whereby said cut-off relay and the other relay are controlled by the subscriber, substantially as described.

19. The combination with a telephone-line, of a line signaling device, a pair of cut-off relays and a source of current normally in circuit in the line, the line signaling device only being responsive to current from said source when a subscriber is calling, a cord-circuit adapted to be connected with the line, a supervisory signal associated therewith and means for establishing a path for current over one side of the cord-circuit to operate one of said cut-off relays and the supervisory signal, and an electromagnetic device adapted to render said supervisory signal inoperative and having its winding disposed in a path of current over the other side of the cord-circuit and telephone-line, the other cut-off relay being also included in the telephone-line, whereby said electromagnetic device and said second relay are controlled by the subscriber, substantially as described.

20. In a telephone system, the combination with a subscriber's line-circuit, of two electromagnetic cut-off devices for the circuit, a line signaling device, and a source of current, one of said cut-off devices being under the control of the central office and the other under the joint control of the central office and subscriber, substantially as described.

21. In a telephone system, the combination with a telephone-line; of two cut-off magnets, a line-signal-controlling electromagnet and a central source of current in series in the line; said cut-off magnets being insensitive and the line-magnet sensitive to calling-current on the

line, one of said cut-off magnets being under the control of the central office and the other under the joint control of the central office and the subscriber, substantially as described.

22. In a telephone system, the combination with a telephone-line; of two low-resistance cut-off magnets, a high-resistance line-signal-controlling magnet and a central source of current in series in the line; whereby when the subscriber calls only the line-signal is operated, one of said cut-off magnets being under the control of the central office and the other under the joint control of the central office and the subscriber, substantially as described.

23. In a telephone system, the combination with a subscriber's line-circuit, of two electromagnetic cut-off devices for the circuit, a line signaling device, a source of current, and means to operate one of said cut-off devices over a local circuit, and for operating the other over the line-circuit, substantially as described.

24. In a telephone system, the combination with a line-circuit; of two cut-off devices, a line signaling device and a source of current in the line-circuit; said cut-off devices being insensitive and the signaling device sensitive to calling-current in the line, and means to operate one of said cut-off magnets over a local circuit and for operating the other over the line-circuit, substantially as described.

25. In a telephone system, the combination with a telephone-line; of two low-resistance cut-off magnets, a high-resistance line signaling magnet and a central source of current in the line; said cut-off magnets being insensitive and the line-magnet sensitive to current in the line when the subscriber calls, and means to operate one of said cut-off magnets over a local circuit and for operating the other over the line-circuit, substantially as described.

26. In a telephone system, the combination with a subscriber's line-circuit, of two cut-off relays, a line signaling device, a source of current and means to operate one of said cut-off relays over a local circuit, and further means for operating the other relay at the desired time, said relays serving to render the line-signal inoperative, substantially as described.

27. In a telephone system, the combination with a subscriber's line-circuit; of two cut-off relays, a line signaling device and a source of current in the circuit; said cut-off relays being unresponsive to calling-current in the line when the subscriber is calling the central office, and means for energizing one of said cut-off relays in a local circuit when the operator's cord-circuit is connected with the line and for operating the other cut-off relay over the telephone-line when the subscriber responds, said relays serving to render the line-signal inoperative, substantially as described.

28. The combination with a telephone-line,

of two cut-off relays in the line, a line signaling device in the line, said cut-off relays being unresponsive to calling-current in the line when the subscriber is calling the central office, one of said relays being located between the connection-terminals of the line and the subscriber's station, a cord-circuit adapted to be connected with the line, a pair of supervisory relays associated therewith, and a central source of current, said relays jointly controlling a supervisory signal, and means when the cord-circuit is connected with the line for including said source of current, one of the supervisory relays and one of the cut-off relays in a local circuit, said local circuit including a part of one side of the talking-circuit, the other cut-off relay being included in the metallic telephone-line during conversation together with said source of current and said second supervisory relay, the first-named supervisory relay serving to actuate the supervisory signal and the second-mentioned supervisory relay serving to render the supervisory signal inoperative, and said source serving to charge the transmitters for talking as well as for the operation of said relays and signals, substantially as described.

29. In a telephone system, the combination with a telephone-line; of two low-resistance cut-off magnets, a high-resistance line-signal-controlling magnet and a central source of current in the line; said cut-off magnets receiving an insufficient flow of current when the subscriber is calling the central office to operate them, and means to cause an increased flow of current through one of said cut-off magnets when a connection is established with the line for operating the same, and for causing an increased flow of current through the other cut-off magnet when the subscriber responds to operate it, substantially as described.

30. In a telephone system, the combination with a subscriber's telephone-line, of two cut-off magnets for the line, a high-resistance line-signal-controlling electromagnet, one of said cut-off magnets being of low resistance and in the path of current when the subscriber calls the central office, said magnet being unresponsive to such calling-current, the other cut-off magnet being also in the path of calling-current in the line but unresponsive thereto, and means for operating one of said magnets when a connection is established and the other during conversation, substantially as described.

31. In a telephone system, the combination with a telephone-line, of two cut-off magnets for the line, one of said magnets being permanently connected in the telephone-line and unresponsive to calling-current therein, a line-signal-controlling magnet, and means for operating both of said cut-off magnets at different stages in the establishment of connections for conversation to render the line-signal inoperative, substantially as described.

32. In a telephone system, the combination with a telephone-line, of two cut-off magnets in the line, one being permanently connected in the line and the other being of low resistance, a line-signal-controlling electromagnet, and means for operating said cut-off magnets at different times in the completion of connections for conversation to render the line-signal inoperative, substantially as described.

33. In a telephone system, the combination with a telephone-line, of two cut-off magnets in the line, said magnets being of low resistance and therefore unresponsive to calling-current in the line, a high-resistance line-signal-controlling magnet for the line, one of said cut-off magnets being permanently connected in the telephone-line, and means for operating the said magnets to render the line-signal inoperative when a connection is established with the line, substantially as described.

34. In a telephone system, a line-circuit comprising two line conductors extending normally to opposite poles of a source of current, two low-resistance cut-off relays included in one of said line conductors, a high-resistance line-relay in the other conductor, said conductors being extended through normal contacts of the cut-off relay in the line toward the subscriber's station, connection-terminals for the line having one set of contacts connected with one line conductor on the substation side of said normal contacts and another set of contacts connected between the said normal contacts of the other conductor and the winding of said relay nearer the substation, substantially as described.

35. The combination with a multiple-switchboard common-battery telephone-line, of testing-contacts connected directly with one side of the line, a source of current connected in the line between the line conductors, an appreciable resistance between said testing-contacts and the current source, an operator's testing-circuit connected with the same pole of said source as the testing-contacts, whereby when a subscriber calls the central office the said testing-contacts are raised to a potential above that of said pole and when the line is tested a flow of current from said battery takes place over the subscriber's line, and means for opening the connection between said testing-contacts and the battery when the cord-circuit is connected with the line for conversation, substantially as described.

36. The combination with a multiple-switchboard common-battery telephone-line, of testing-contacts connected directly with one side of the line, a source of current connected in the line between the line conductors, an appreciable resistance between said testing-contacts and the current source, an operator's testing-circuit connected with the same pole of said source as the testing-contacts, whereby when a subscriber calls the central office

the said testing-contacts are raised to a potential above that of said pole and when the line is tested a flow of current from said battery takes place over the subscriber's line, and a relay included in the telephone-line when the cord-circuit is connected therewith for conversation, said relay serving to open the connection between said testing-contacts and the battery, substantially as described.

37. The combination with a telephone-line having connection-terminals conductively associated therewith during connections for conversation, of an individual line signaling device therefor, a cut-off relay for the line and individual thereto, said cut-off relay having its winding permanently connected in the metallic talking-line circuit and being actuated during a connection to render the line signaling device inoperative, substantially as described.

38. The combination with a telephone-line having connection-terminals conductively associated therewith during connections for conversation, of a line signaling device therefor, and an electromagnetic cut-off device for the line having its winding included in one line conductor and in the talking-circuit during a connection, said device serving when operated to render the line-signal inoperative, substantially as described.

39. The combination with a telephone-line, of a line signaling device therefor, and a source of current, a cut-off relay for the line having its winding included in the talking-circuit during a connection, the normal connection of the line with the said device and source of current being extended through contacts of said relay, whereby during a connection the said relay is operated to render the line signaling device inoperative, substantially as described.

40. The combination with a telephone-line, of a cut-off relay therefor having its winding included in the metallic circuit of the line and in the path of talking-currents during a connection, a cord-circuit adapted to be connected therewith, a source of current bridged across the cord-circuit, whereby when the cord-circuit is connected with the line for conversation the said cut-off relay is operated, said relay serving to render the line signaling device inoperative, substantially as described.

41. The combination with a telephone-line, of a cut-off relay therefor having its winding connected in one of the line conductors and in the talking-circuit, a cord-circuit having a source of current associated therewith, a supervisory signal associated with the cord-circuit and placed in condition to operate by current flowing over one side of the cord-circuit when the cord-circuit is connected with the telephone-line, said signal being rendered inoperative by current flowing from said source over the metallic-line circuit, said cut-off relay being operated at the same time from

said source to render the line signaling device inoperative, substantially as described.

42. The combination with a telephone-line, of a cut-off relay therefor connected in the talking-line and between the jacks of the telephone-line and the substation, said relay being operated during a connection to render the line signaling device inoperative and to cut off all ground connections from the metallic talking-circuit, substantially as described.

43. The combination with a telephone-line, of a cut-off relay therefor having its winding included in one of the line conductors and in the talking-circuit during an established connection, a source of current included in the metallic line during the connection to furnish current for talking purposes; said cut-off relay having two sets of normal contacts each set being included in the normal connection of the telephone-line with its line signaling device and battery, substantially as described.

44. In a telephone system, the combination with a telephone-line, of a line-signal, a cut-off relay responsive to current in the line during conversation, a cord-circuit, a supervisory signal associated with said cord-circuit and adapted to be put in condition to be operated by current over a local circuit including a portion of the talking-circuit when a connection is first established, said relay in the line serving when actuated to interrupt the local path for such current, substantially as described.

45. In a telephone system, the combination with a telephone-line, of a line-signal, a cut-off relay responsive to current in the line during conversation, a cord-circuit, a supervisory signal associated therewith, said signal being placed in condition to be operated by current over a portion of one side of the talking-circuit and ground when a connection is first established with the line and to be rendered inoperative by current over the metallic line when the subscriber responds, said relay in the line serving when actuated to interrupt the said ground connection and at other times to complete the same, substantially as described.

46. In a telephone system, the combination with a telephone-line, of a line-signal, a cut-off relay permanently connected in the talking-circuit and responsive to current therein during conversation, a cord-circuit, a supervisory signal associated therewith and rendered operative by current over one side of the talking-circuit and ground and inoperative by current over both sides of the talking-circuit, said relay serving when actuated to cut off the ground connection for such operating-current, substantially as described.

47. In a telephone system, the combination with a telephone-line, of a line-signal, a cut-off relay in the external portion of the telephone-line in the path of current during conversation and actuated by said current therein during conversation, a switch at the substa-

tion to control said relay, and a ground-tap of the line controlled by said relay, substantially as described.

48. In a telephone system, the combination
5 with a telephone-line, of a line-signal, a cut-off relay and a source of current in the line during conversation, said relay being responsive to current from said source during conversation, a branch conductor connected with
10 the line over which current flows from said battery when the branch is completed, and a resistance included in said conductor, whereby when the metallic-line circuit is closed said relay is actuated, said relay serving to control
15 the continuity of said branch, substantially as described.

49. In a telephone system, the combination with a telephone-line, of a cut-off relay in the talking-circuit of the line, a source of current
20 bridged across the line during conversation, a third conductor connected with one side of said line and with the opposite pole of said source from that with which the said side of the line is connected, said relay serving when
25 actuated to open said third conductor, and a resistance included in said third conductor to cause a sufficient flow of current over the talking-circuit to operate said relay, substantially as described.

30 50. In a telephone system, the combination with a telephone-line, of a relay connected in the talking-circuit thereof, a ground branch from one side of the line controlled by said relay, a cord-circuit, a source of current and
35 a pair of relays associated therewith, a supervisory signal controlled by said relays, one of said relays being energized by current over a portion of one side of the talking-circuit and said ground branch when a connection is es-
40 tablished and serving to operate said super-

visory signal, and the other being energized by current from said source over the metallic line to render the signal inoperative when the subscriber is talking and the said first-named relay is actuated, substantially as described. 45

51. In a telephone system, the combination with a telephone-line, of a line-signal, a cut-off relay to render the line-signal inoperative connected in the talking-circuit of the line and actuated by current therein during con- 50 versation, a branch conductor of the line controlled by said relay, a cord-circuit to establish connection with the line for conversation, a supervisory signal associated therewith, said signal being caused to operate by current over 55 said branch when the said relay is deenergized, substantially as described.

52. In a telephone system, the combination with a line-circuit having jacks connected therewith, a subscriber's station on said cir- 60 cuit, a cut-off relay, a line-relay and a source of current, said cut-off relay having its winding in said circuit between the subscriber's station and the jacks, and adapted to be operated to render the line-relay inoperative, 65 substantially as described.

53. The combination with a telephone-line, of a signaling device connected to the said line, a source of electricity for operating the said device, a relay in series with the talking 70 telephone-line, and means operated by the said relay whereby the signaling device and source are disconnected from the telephone-line.

In witness whereof I hereunto subscribe my 75 name in the presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:

E. F. BECK,

W. A. FRICKE.