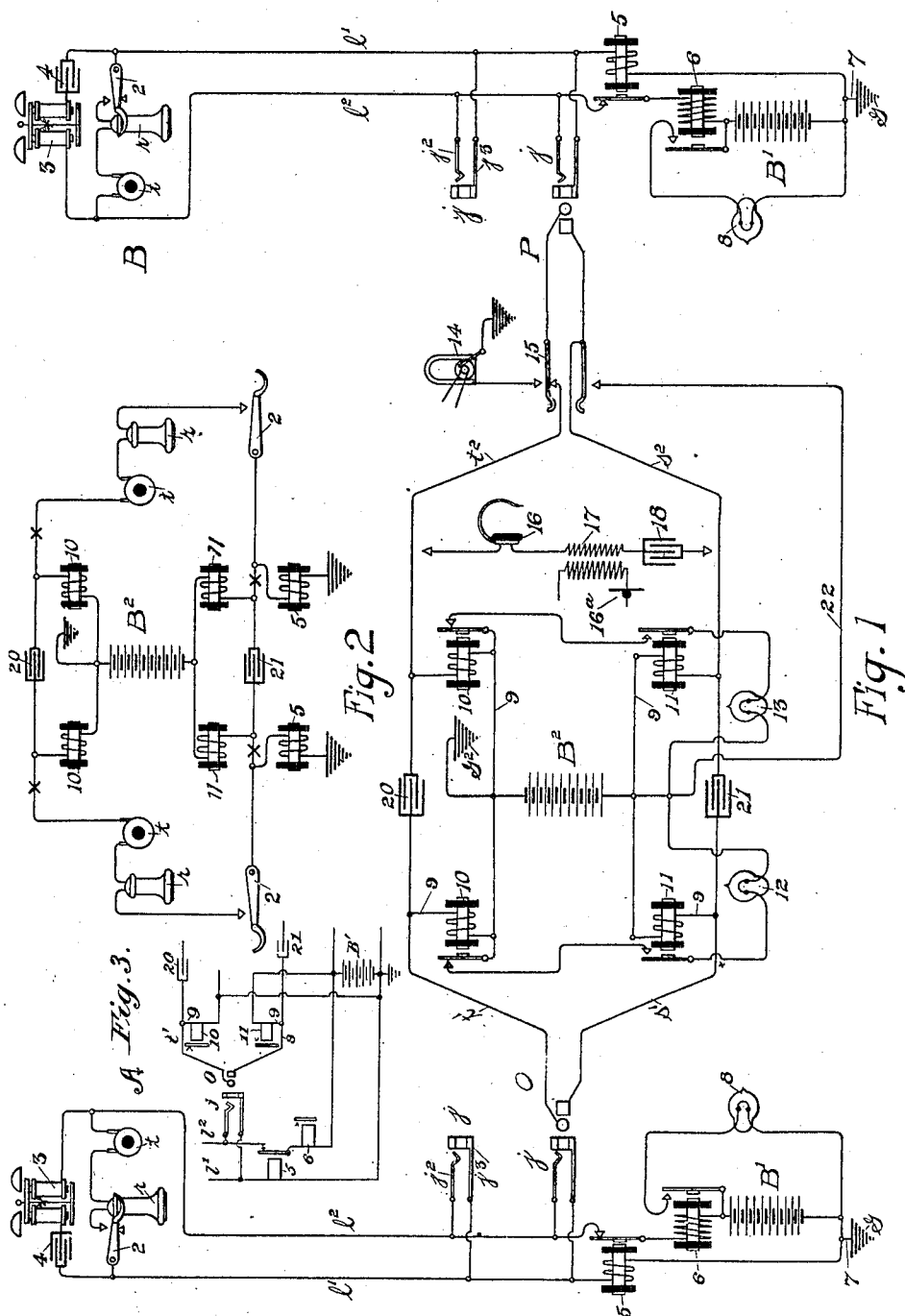


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PATENTED APR. 9, 1907.

W. W. DEAN.
TELEPHONE SYSTEM.
APPLICATION FILED MAY 11, 1901.



Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 849,375.

Specification of Letters Patent.

Patented April 9, 1907.

Application filed May 11, 1901. Serial No. 59,876.

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, 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 wherein subscribers' lines terminate at the central office or offices and at which provision is made for interconnecting the various lines for conversational purposes.

It has special relation to those systems employing central sources of current-supply, and in which the signaling to the central office by the subscriber is automatic. Such systems commonly involve a signaling device and a source of current connected with each line whereby the subscriber may call central by completing the circuit of said source at his station, as by taking up his receiver. There is also a so-called "cut-off relay" adapted to be actuated by the operator in making connections with the line for conversational purposes to render said signaling device inoperative, as by opening its circuit or cutting off the line altogether beyond the point of connection.

This invention has for its object the simplification of the circuits, connections and arrangements by which the above operations are accomplished, and the provision of a system generally which shall be at once rapid, positive, and efficient.

It comprises a telephonic line-circuit having a cut-off relay, a line-relay or other signaling device, and a source of current associated therewith, the arrangement being such that the taking up of the subscriber's telephone operates the line-relay or other signaling device, but does not operate the cut-off relay, the latter not being operated to render the line-relay or other signaling device inoperative until a conversational circuit is established by the operator.

The invention further consists of the construction, arrangement, and combinations 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 the several views, and in which—

Figure 1 is a diagram of two subscribers'

lines and a central-office connective apparatus, and Fig. 2 is a diagram in simple form of a completed conversational circuit, and Fig. 3 is a diagram showing one generator for both the telephone-line and the cord-circuit.

In these figures the subscribers' stations A and B are shown provided with the usual apparatus adapted for use in connection with central sources of current-supply, though any may be used, and it comprises a receiver *r*, a transmitter *t*, and a telephone hook-switch 2, as well as a bell 3 and a condenser 4 in a branch across the line. The line-circuits are extended by the limbs *l'* and *l''* to the central office, where they connect first with the multiple jacks *j*, having the tip-springs *j''* and sleeve-rings *j'''* and include the battery B'. The limb *l''* passes through the back contact and armature of the comparatively insensitive cut-off relay 5 and the magnet-winding of the comparatively sensitive line-relay 6, while the other limb *l'* includes the winding of the cut-off relay 5 and is grounded at G by the branch 7. The line-relay 6 is adapted when energized to close a local circuit containing the individual line-lamp 8 and its own armature and forward contact, as well as the battery B'.

The operator's cord-circuit and connective apparatus comprise the answering-plug O, having the tip and sleeve contacts connected, respectively, with the tip and sleeve strands *t'* and *s'*, which are extended by branches 9 to the battery B², the latter being grounded at G². The calling-plug P has its similar contacts connected with like tip and sleeve strands *t''* and *s''*, which are extended by similar branch conductors 9 to the main battery B². Condenser 20 connects inductively the two tip-strands and the similar condenser 21 connects the two sleeve-strands. The branch conductors 9 include supervisory relays 10 and 11, which are adapted to control the supervisory lamps 12 and 13, associated, respectively, with the answering and calling plugs. The local circuits of said lamps include the main battery B² and the armatures and contacts of the relays 10 and 11, of which relays the former are adapted to open the local circuits when energized and the latter to close them. A ringing-generator 14, grounded on one side, is adapted to be

connected with the calling-plug P by means of the ringing-key 15, the strand s^2 not being opened at this time. The operator's head-telephone 16 (shown diagrammatically) is adapted to be bridged across the line, and its branch includes the secondary of its induction-coil 17 and the condenser 18, the transmitter 16^a of the operator's set (of which the connections are not fully shown) being preferably fed from the battery B² in any well-known manner.

When a subscriber calls for a connection by taking up his receiver, he closes the line-circuit at his station through the telephone hook-switch 2 and operates the line-relay 6 over the two limbs of the telephone-line through the cut-off relay 5 and the main battery B'. Owing to the fact that the line-relay is more sensitive than the cut-off relay, the former only will be operated at this time. The operation of this line-relay will of course close the local lamp-circuit, which lamp will become lighted and indicate to the operator that a connection is desired. Upon observing this signal she inserts the answering-plug O of the cord-circuit into the subscriber's jack and by so doing throws current upon the cut-off relay from the battery B², over a circuit from ground G² at the cord-circuit, through battery B², branch conductor 9, strand s' of the calling-plug O, the sleeve-contact of said plug, the test-ring j^3 of the jack j , over a portion of the limb l' of the subscriber's line, through the winding of the cut-off relay 5, over the branch 7, to ground at G. The current now flowing through the cut-off relay is sufficient to operate it and open the opposite line-limb l^2 through its armature and back contact to cut out the line-relay and the battery B', which renders the line-relay inoperative and causes the retirement of the line-lamp 8. The insertion of said plug and the completion of the above-described circuit also energizes the supervisory relay 11, connected with the sleeve-strand s' of the cord-circuit, to close part of the local circuit of the supervisory lamp 12, which is associated with the plug O, and as the subscriber's line is at this time also closed at his station the supervisory relay 10, which is connected with the tip-strand, is also operated from battery B² over the metallic line and the two strands of this portion of the cord-circuit. This serves to open the circuit of the supervisory lamp 12 and causes it to remain dark. Upon ascertaining the number of the subscriber wanted his line is tested by the operator, and if not found busy the calling-plug P is duly inserted. This operates the cut-off relay 5 of this line, thereby opening the circuit of the relay 6, as before described. The ringing-key 15 is then operated to connect the calling-generator

The ringing-circuit is from ground at the

generator 14, through the generator, tip-strand of plug P, line conductor l^2 , through the subscriber's bell and condenser, back to the central office over line conductor l' , sleeve-strand of plug P, through conductor 22 and the battery B², to ground G². The branch conductor 22 is not absolutely necessary, as the sleeve-strand s^2 could be depended upon, but is used to prevent any possible rattling of relay 11 in the strand s^2 . One object of maintaining this connection of the battery B² is to keep the cut-off relay 5 operated during ringing. The insertion of the calling-plug P operates the supervisory relay 11 over a similar circuit to the one previously described; but before the wanted subscriber responds relay 10 is not operated, and therefore the supervisory lamp 13 is lighted to indicate to the operator that the subscriber has not yet responded. When he takes up his receiver, however, the relay 10 is operated over a circuit, as before described, including the two limbs of the line, both strands of the cord-circuit, and the battery B², which serves to retire the supervisory lamp 13 and indicates to the operator that the subscribers are in communication. The conversational or voice currents pass serially and inductively through the condensers 20 and 21 in the cord-circuit and are prevented from being short-circuited across the relay-bridge by the impedance of the relays 10 and 11. Under these conditions, as shown more clearly in Fig. 2, a ground branch exists from one side of each of the metallic lines and includes cut-off relay 5, which relay, however, has a sufficient impedance to prevent the passage of voice-currents. The circuit over which the cut-off relay is operated is also clearly shown here. It is readily seen from this figure that as soon as a connection is made with a line the cut-off relay 5 and the supervisory relay 11 will be operated, these being in series between the battery and ground. It is also seen that the relays 10 will be operated only by current flowing over the metallic circuit, and will therefore be under the control of the subscriber. At the termination of the conversation when the subscribers return their receivers to the hooks the supervisory relays 10 are deenergized, and the circuits of the lamps 12 and 13 are thereby closed and cause the lamps to glow to indicate to the operator that the conversation has ceased, whereupon she takes down the connection, thus restoring all parts to normal condition.

In making the busy test the operator merely touches the tip of the calling-plug P to the test-ring j^3 of the subscriber's jack. If the line is busy, these test-rings will be connected with a battery, and the circuit when testing is completed over the tip-strand of the plug to ground G², which serves, by means of the surge of current through the

condenser branch, which is then closed, to give a slight click in the operator's receiver. If not busy, no click will be heard.

It will be observed that when a subscriber first calls central and before the operator answers the test-terminals of the jacks are connected with the live pole of the battery through the subscribers' instruments and that if the tip of a plug is then touched to the said test-contacts a flow of current thereover will result. Having reference to the right-hand side of Fig. 1, the path for such current may be traced from the live pole of battery B', line conductor l^2 , through the substation instruments t and r , thence back over conductor l' , the test-ring of the tested jack, and over the tip-strand t^2 , to ground G². This would change the potential of the charge on the condenser 18 in the operator's bridge, which would cause a flow of current in the bridge and a "click" in the operator's telephone. The flow of current through this strand t' is of course dependent upon an appreciable resistance between the test-terminals and the other pole of the battery, for otherwise the test-terminals would be practically at the same potential as this pole of the battery and no flow would result. The cut-off relay 5 provides this resistance.

I prefer to secure the difference in sensitiveness between the line and the cut-off relays by winding the line-relay with a much greater number of turns of wire and of higher ohmic resistance than the cut-off relay, so that the current flowing in the line when the subscriber calls is insufficient to operate the cut-off relay, but is sufficient to operate the line-relay, and when the operator's plug is inserted in a jack the current then sent through the cut-off relay is sufficient to operate it. Of course this difference in sensibility may be secured mechanically or by other means.

The dimensions of the various parts are not the essence of the invention; but I have secured good results with line-relays of one thousand ohms resistance, cut-off relays of two hundred and fifty ohms resistance, and the other parts may be the kind ordinarily used.

It will be understood, of course, that the grounds referred to in the preceding description may be the central-office return or the common ground and also that the batteries B' and B² may be, and in practice usually are, one and the same. This latter feature is shown in Fig. 3, in which the battery B' furnishes the current to the cord-circuit over leads extending directly to its poles, as shown. The parts are here designated by the same reference characters as before, and the operation of making, unmaking, and supervising connections is also the same as above described. Any electromagnetic signaling device may be substituted for the line-relay.

While the invention has been described with particular reference to the details of arrangement and construction, I would have it understood that it is not to be so limited, as various changes, alterations, and modifications may be made therein and still come within its purview; but

What I do claim, and desire to secure by Letters Patent, is—

1. In a telephone system, the combination with a subscriber's line-circuit, of a cut-off relay and a battery in said circuit, a signaling device, and means for operating said cut-off relay to render said signaling device inoperative.

2. In a telephone system, the combination with a subscriber's line-circuit, of a cut-off relay and a battery in said circuit, a signaling device, and means for operating said cut-off relay to open the circuit of said signaling device.

3. In a telephone system, the combination with a telephone line-circuit, of a cut-off relay and a battery in said circuit, a line-relay, and means to operate said cut-off relay to render said line-relay inoperative.

4. In a telephone system, the combination with a telephone line-circuit, of a cut-off relay and a battery in said circuit, a line-relay, and means for operating said cut-off relay to open the circuit of said line-relay.

5. In a telephone system, the combination with a line-circuit, of a cut-off relay, a line-relay, and a source of current all in said circuit, and means for operating the cut-off relay to cut out the line-relay.

6. In a telephone system, the combination with a line-circuit, of a normally inoperative cut-off relay in said circuit, a line-relay and a source of current also in said circuit, and means for rendering the cut-off relay operative to cut out the line-relay.

7. In a telephone system, the combination with a subscriber's line-circuit, of a cut-off relay, a line-relay, and a source of current all in said line-circuit, and means actuated by the subscriber in calling for operating said line-relay, and further means actuated in making a connection with the line to operate said cut-off relay to cut out the line-relay.

8. In a telephone system, the combination with a line-circuit, of a cut-off relay in the line, a source of current in series with the said cut-off relay, a line-relay in series with said cut-off relay, and means when a connection is made with the line for operating the cut-off relay to render said line-relay inoperative.

9. In a telephone system, the combination with a line-circuit, of a cut-off relay, a line-relay and a source of current all in said line, an operator's connective circuit, and means for operating said cut-off relay when the operator's circuit is connected with the line.

10. The combination with a telephone-

line, of a central battery with which the limbs of said line are connected, a line-relay in one limb of the line, and a cut-off relay in the other limb adapted to open the first limb to render the line-relay inoperative, substantially as described.

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

12. In a telephone system, the combination with a subscriber's line having conductors normally extending to opposite poles of a source of current, a signal-controlling electromagnet in one of said conductors, a switch in said conductor between said magnet and the subscriber's station, a cut-off relay having a winding connected in the other conductor of said line, but unresponsive to current therein when the subscriber is calling the central station, said relay serving to control said switch, substantially as described.

13. In a telephone system, the combination with a subscriber's line-circuit, of a low-resistance cut-off relay, a high-resistance line-relay, and a source of current all in said line-circuit, whereby when the subscriber calls, the cut-off relay is not operated.

14. In a telephone system, the combination with a subscriber's line-circuit, of a low-resistance cut-off relay, a high-resistance line-relay and a source of current all in said line-circuit, whereby when the subscriber calls the cut-off relay will not be operated, and means for operating said cut-off relay to cut out the line-relay when connection is made with the line.

15. In a telephone system, the combination with a subscriber's line-circuit, of a low-resistance cut-off relay, a high-resistance line-relay, and a source of current all in said line-circuit, whereby when the subscriber calls the cut-off relay will not be operated, and means to cause a greater flow of current through said cut-off relay in making a connection with the line to operate it.

16. In a telephone system, the combination with a subscriber's line-circuit, of a non-sensitive cut-off relay in the line-circuit, a sensitive line-relay and a source of current whereby when the subscriber calls the cut-off relay is not operated.

17. In a telephone system, the combination with a subscriber's line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay for the line placed in the path of current from said source when the subscriber is calling the central office, but which is unresponsive to such calling-current, and means to operate said cut-

off relay when a connection is established with the line to render said signal-controlling electromagnet inoperative, substantially as described.

18. In a telephone system, the combination with a line-circuit, of a low-resistance cut-off relay, a high-resistance line-relay and a source of current all in said line, a cord-circuit, a source of current to furnish current for talking associated with said cord-circuit, and means for throwing additional current onto the cut-off relay from said talking source when the cord-circuit is connected with the line.

19. In a telephone system, the combination with a subscriber's line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay having a winding connected directly in the path of current flowing in the line when the subscriber is calling the central office, means to render said relay unresponsive to such calling-current, and further means to operate said relay when a connection is established with the line to render said signal-controlling electromagnet inoperative, substantially as described.

20. In a telephone system, the combination with a subscriber's line, of a signal-controlling electromagnet and a source of current in the line, a cut-off relay connected directly in the path of current flowing in said line when a subscriber is calling the central office, the said relay being unresponsive to such calling-current, and means for directing a current through said relay to which the relay is responsive when a connection is established with the line, said relay serving to render said signal-controlling electromagnet inoperative, substantially as described.

21. In a telephone system, the combination with a subscriber's line, of a source of current connected between the limbs thereof, a signal-controlling electromagnet in one of said limbs, a cut-off relay having an actuating winding connected in the other of said limbs, normally closed switch-contacts of said relay included in the other limb of the line, said relay being unresponsive to current in the line from said source when the subscriber is calling the central office, and means for sending an actuating-current from said source through said relay-winding as long as the line is switched for use to operate said relay and open said limb through the relay-contacts to cut out said magnet, substantially as described.

22. In a telephone-exchange system, the combination with a telephone line-circuit running from a central exchange to a substation and adapted to be closed at the substation, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-

relay normally included in said line-circuit and adapted to be actuated upon the closure of said line-circuit, a signal controlled by said line-relay, a cut-off relay whose winding is permanently included in said line-circuit and adapted to remain inoperative upon a closure of said line-circuit, and means whereby the connection of said cord connecting apparatus with said line-circuit causes an actuation of said cut-off relay to destroy the control of said signal by said line-relay, substantially as described.

23. In a telephone-exchange system, the combination with a telephone line-circuit running from a central exchange to a substation and adapted to be closed at the substation, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-relay normally included in said line-circuit and adapted to be actuated upon the closure of said line-circuit, a signal controlled by said line-relay, a marginally-adjusted cut-off relay whose winding is permanently included in said line-circuit and adapted to remain inoperative upon a closure of said line-circuit, and means whereby the connection of said cord connecting apparatus with said line-circuit causes an actuation of said cut-off relay to destroy the control of said signal by said line-relay, substantially as described.

24. In a telephone-exchange system, the combination with a telephone line-circuit running from a central exchange to a substation and adapted to be closed at the substation, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-relay normally included in said line-circuit and adapted to be actuated upon the closure of said line-circuit, a signal controlled by said line-relay, a marginally-adjusted cut-off relay controlling the circuit through said line-relay permanently included in said line-circuit and adapted to remain inoperative upon a closure of said line-circuit, and means whereby the connection of said cord connecting apparatus with said line-circuit causes an actuation of said cut-off relay to destroy the control of said signal by said line-relay, substantially as described.

25. In a telephone system, the combination with a subscriber's line-circuit, of a cut-off relay in the line, a line-relay, a source of current in the line, and means for connecting said cut-off relay in a local circuit to energize the same to render the line-relay inoperative.

26. In a telephone system, the combination with a subscriber's line-circuit, of a cut-off relay in the line, a line-relay and a source of current in the line, a cord-circuit, and a local circuit adapted to be completed when the cord-circuit is connected with the line to energize the cut-off relay.

27. In a telephone system, the combina-

tion with a line-circuit, of a cut-off relay in the line, a line-relay, and a source of current all in said line-circuit, a cord-circuit, and means to include the cut-off relay and said source in a local circuit when the cord-circuit is connected with the line, said source serving also to furnish current to the substation for talking purposes.

28. The combination with a telephone-line, of a cut-off relay and a line-relay in the line, a battery, and means to close said cut-off relay and battery in a local circuit when a connection is established with the line, substantially as described.

29. The combination with a telephone-line, of a central battery, a cut-off relay and a line-relay in the line, and a third conductor adapted to be connected around the cut-off relay and battery whereby the cut-off relay is actuated when a connection is established with the line to render the line-relay inoperative, substantially as described.

30. The combination with a telephone-line, of a central battery with which the limbs of said line are connected, a cut-off relay and a line-relay for the line, one side of said cut-off relay being connected with one pole of the battery, a spring-jack connected with the line, a cord-circuit, an additional conductor extending from the other pole of the battery to one strand of the cord-circuit, and means to connect said strand with the limb of the telephone-line connected with the other side of said cut-off relay when a connection is made with the line, whereby the cut-off relay is operated to render the line-relay inoperative, substantially as described.

31. The combination with a subscriber's line normally extending to opposite poles of a source of current, a signal-controlling electromagnet in one of said conductors, a cut-off relay in the second conductor and controlling the continuity of the first-named conductor, a cord-circuit adapted to be connected with the line in response to a call of the subscriber, and connections from said cord-circuit to said battery so as to include the same together with the winding of the cut-off relay in a local circuit, whereby said cut-off relay is operated upon the connection of the cord-circuit to the line and the signal-controlling electromagnet is rendered inoperative, said battery serving to furnish current for talking purposes, substantially as described.

32. The combination with a telephone-line, of a cut-off relay, a line-relay and a battery in the line, and means to shunt the resistance in the line to permit an increased flow of current through the cut-off relay to operate the same when connection is established with the line, substantially as described.

33. The combination with a telephone-line, of a high resistance line-relay, a low-re-

sistance cut-off relay and a battery in the line, and means to shunt the line-relay when a connection is established with the line to cause an increased flow of current through the cut-off relay to operate the same, substantially as described.

34. In a telephone-exchange system, the combination with a telephone line-circuit running from a central exchange to a substation and adapted to be closed at the substation, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-relay of high resistance normally included in said line-circuit and adapted to be actuated upon the closure of said line-circuit, a signal controlled by said line-relay, a cut-off relay of low resistance permanently included in said line-circuit and adapted to remain inoperative upon a closure of said line-circuit, and means whereby the connection of said cord connecting apparatus with said line-circuit provides an electrical path of decreased resistance through said cut-off relay, whereby the same is actuated to destroy the control of said signal by said line-relay, substantially as described.

35. In a telephone-exchange system, the combination with a telephone line-circuit running from a central exchange to a substation and adapted to be closed at the substation, of cord-connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-relay normally included in said line-circuit and adapted to be actuated upon the closure of said line-circuit, a signal controlled by said line-relay, a cut-off relay permanently included in said line-circuit and adapted to remain inoperative upon a closure of said line-circuit, and means whereby the connection of said cord connecting apparatus with said line-circuit provides an electrical path of decreased resistance through said cut-off relay, whereby the same is actuated to destroy the control of said signal by said line-relay, substantially as described.

36. In a telephone-exchange system, the combination with a telephone line-circuit, of cord connecting apparatus for connecting said line-circuit with another for conversation, a marginally-adjusted cut-off relay serially included in said circuit, and a line-relay normally serially included in said circuit, the connection of said cord connecting apparatus with said line-circuit serving to provide a circuit in shunt of said line-relay, substantially as described.

37. In a telephone-exchange system, the combination with a telephone line-circuit, of cord connecting apparatus for connecting said line-circuit with another for conversation, a marginally-adjusted cut-off relay serially included in said circuit, and a line-relay normally serially included in said circuit,

the connection of said cord connecting apparatus with said line-circuit serving to provide a circuit of low resistance in shunt of said line-relay, substantially as described.

38. In a telephone-exchange system, the combination with a telephone line-circuit, of cord connecting apparatus for connecting said line-circuit with another for conversation, a marginally-adjusted cut-off relay serially included in said circuit, and a line-relay normally serially included in said circuit, the connection of said cord connecting apparatus with said line-circuit serving to provide a circuit in shunt of said line-relay, said shunt-circuit serving to control the supply of current to the supervisory signaling apparatus, substantially as described.

39. In a telephone-exchange system, the combination with a telephone line-circuit, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a marginally-adjusted cut-off relay of low resistance serially included in said circuit, and a line-relay of high resistance normally serially included in said circuit, the connection of said cord connecting apparatus with said line-circuit serving to provide a circuit of low resistance in shunt of said line-relay, said shunt-circuit serving to control the supply of current to the supervisory signaling apparatus, substantially as described.

40. In a telephone-exchange system, the combination with a telephone line-circuit, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-relay normally serially included in said circuit, a signal controlled by said relay, a marginally-adjusted cut-off relay serially included in said circuit, and a switch controlled by said cut-off relay normally making contact to close the line-circuit through said line-relay, said cut-off relay being adjusted so as not to actuate said switch upon the closure of the line-circuit through said cut-off relay and said line-relay, the connection of said cord connecting apparatus with said line-circuit serving to provide a circuit of decreased resistance in shunt of said line-relay, whereby said cut-off relay is actuated to break connection between said switch and its associated contact, thereby breaking the circuit through said line-relay, substantially as described.

41. In a telephone-exchange system, the combination with a telephone line-circuit running from a central exchange to a substation and adapted to be closed at the substation, of cord connecting apparatus at the central exchange for connecting said line-circuit with another for conversation, a line-relay normally included in said line-circuit and adapted to be actuated upon the closure of said line-circuit, a signal controlled by said

line-relay, a marginally-adjusted cut-off relay permanently included in said line-circuit and adapted to remain inoperative upon closure of said line-circuit and means whereby the connection of said cord connecting apparatus with said line-circuit provides an electrical path of decreased resistance through said cut-off relay, whereby the same is actuated to destroy the control of said signal by said line-relay, substantially as described.

42. In a telephone system, the combination with a telephone line-circuit, a cut-off relay in the line-circuit, a line-relay, and a source of current also in said line-circuit, a cord-circuit, a battery connected with the cord-circuit and adapted to furnish current for talking purposes, and means for connecting said battery and cut-off relay in a local circuit when a connection is established with the line, said local circuit including part of the talking-circuit.

43. The combination with a telephone-line, a line-relay, a battery and a cut-off relay in the line, means to close a circuit through the cut-off relay when a connection is established with the line, said circuit including a portion of one side of the talking-circuit, substantially as described.

44. The combination with a telephone-line, a line-relay, a battery, a cut-off relay permanently connected in the line, and means to close a circuit through the cut-off relay and battery when a connection is established with the line, said circuit including a portion of one side of the talking-circuit, substantially as described.

45. The combination with a telephone-line, of a line-relay, a battery and cut-off relay in the line, and means to close the circuit through the cut-off relay when a connection is established with the line, said circuit including a portion of the talking-circuit of the telephone-line and cord-circuit, substantially as described.

46. The combination with a telephone-line, of a line-relay, a battery and cut-off relay in the line, and means to close a circuit through the cut-off relay when a connection is established with the line, said circuit including a portion of one side of the talking-circuit of the telephone-line and cord-circuit, substantially as described.

47. In a telephone system, the combination with a subscriber's line normally extending to opposite poles of a source of current, a signal-controlling electromagnet in one of said conductors, a cut-off relay having a winding connected in the opposite conductor and controlling the continuity of the first-named 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.

48. The combination with a multiple-switchboard telephone-line, of a plurality of connection-terminals therefor permanently connected therewith, a line-signaling device for the line to indicate a call from the substation to the central office, a cut-off relay for the line to render said signaling device inoperative when a connection is established with the line for conversational purposes, a cord-circuit to establish such conversational circuits, and a central source of current associated with the cord-circuit and included in the metallic circuit of the line during a connection to furnish current for talking and for the operation of said cut-off relay, said relay-circuit including a portion of one side of the talking-circuit, substantially as described.

49. The combination with a telephone-line, a line-relay, a cut-off relay and source of current normally in circuit with the line, the line-relay only being responsive 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, and means for establishing a path for current over one side of said cord-circuit to operate the said cut-off relay and supervisory signal, and a relay adapted to render the said signal inoperative and having its winding disposed in the path of current over the other side of the said cord-circuit and telephone-line, said relay being controlled by the subscriber, substantially as described.

50. The combination with a telephone-line, a line-relay, a cut-off relay and source of current normally in circuit with the line, the line-relay only being responsive 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, and means for establishing a path for current over one side of said cord-circuit to operate the said cut-off relay and supervisory signal, and an electromagnetic device adapted to render said signal inoperative and having its winding disposed in the path of current over the other side of the said cord-circuit and telephone-line, said electromagnetic device being controlled by the subscriber, substantially as described.

51. The combination with a telephone-line, a line-signal, a cut-off relay and source of current normally in circuit with 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 when a connection exists, said local circuit being free from the control of the subscriber, and means controlled by the subscriber for rendering said signal inoperative by current passed over the line-circuit, substantially as described.

52. The combination with a multiple-switchboard telephone-line, of a battery connected between one line conductor and a third conductor, the other line conductor being also connected with said third conductor, two or more busy-testing terminals connected with the latter line conductor, and a cut-off relay for the line located between the testing-terminals and the third conductor and possessing an appreciable resistance, whereby when a subscriber calls and connects two line conductors together the testing-terminals are raised to a potential above that of the third conductor and the line is in a condition to test busy.

53. In a telephone system, the combination with a telephone-line, of a plurality of connection-terminals permanently connected with the line, testing-contacts for said terminals permanently connected with the sleeve-limb of the line, a line-signaling device for the line, a cut-off relay permanently connected with said sleeve-limb of the line, a cord-circuit having a connecting-plug to be inserted in said connection-terminals to establish conversational circuits with the line, and a central source of current included in the metallic line during a connection and serving to furnish current for talking, to alter the electrical condition of said testing-contacts of the connection-terminals, and for the operation of said cut-off relay; said relay-circuit including a portion of the sleeve-strand of the cord-circuit, the sleeve-contacts of the connected plug and connection-terminal, and a portion of the sleeve-limb of the telephone-line, substantially as described.

54. In a telephone system, the combination with a telephone-line, of a plurality of connection-terminals therefor, testing-contacts for said terminals permanently connected with the talking-circuit including the telephone-line, a line-signaling device for the line to indicate a call at the central office from the substation, a cut-off relay for the line permanently connected with a limb of the talking-circuit and arranged when operated to render said signaling device inoperative, a cord-circuit to cooperate with said connection-terminals to establish conversational circuits with the line, a central source of current associated with the cord-circuit and included in the metallic circuit of the line during an established connection to furnish current for talking, and said relay-circuit including a portion of one side of the talking-circuit, substantially as described.

55. The combination with a telephone-line, of connection-terminals for the line having contact-surfaces connected each with one of the line conductors, a line-signal for the line, a cut-off relay therefor connected with one of the line conductors, a cord-circuit and a connecting-plug having contact-surfaces adapted to register with the like sur-

faces of the connection-terminals of the line when the plug is inserted therein, a battery to furnish current for talking connected with the strand of the cord-circuit corresponding to the line conductor with which the cut-off relay is connected and adapted when a conversational circuit is established to be included in circuit with said cut-off relay to operate the same and thereby render the line-signaling device inoperative, a supervisory relay in the path of current from said battery over the said strand of the cord-circuit, a ringing-generator adapted to be connected with the cord-circuit to call the wanted subscriber and having its path for current completed through said battery, and means for maintaining the supervisory and cut-off relays operated during ringing and for preventing the chattering of the said supervisory relay by the ringing-current, substantially as described.

56. The combination with a telephone-line, of connection-terminals for the line having contact-surfaces connected each with one of the line conductors, a line-signal for the line, a cut-off relay therefor connected with one of the line conductors, a cord-circuit and a connecting-plug having contact-surfaces adapted to register with the like surfaces of the connection-terminals of the line when the plug is inserted therein, a battery connected with the strand of the cord-circuit corresponding to the line conductor with which the cut-off relay is connected and adapted when a conversational circuit is established to furnish current for talking and to be included in a local circuit with said cut-off relay to operate the same and thereby render the line-signaling device inoperative, a supervisory relay in the path of current from said battery over the said strand of the cord-circuit, a ringing-generator adapted to be connected with the cord-circuit to call the wanted subscriber and having its path for current completed through said battery, and means made operative in the use of the ringing-key to prevent chattering of the supervisory relay, substantially as described.

57. The combination with a telephone-line, of a line-signaling device and a battery connected between its line conductors, a cut-off relay connected between one of said conductors and ground and adapted when actuated to render the line-signaling device operative, a cord-circuit, a battery connected between ground and the strand of said circuit that is adapted to be connected with the line conductor with which said cut-off relay is connected whereby said battery and cut-off relay are included in a local circuit during a connection, a supervisory relay included in the path of current over said strand and operated by the current, a ringing-key connected between the battery and the terminals of the cord-circuit, a ringing-generator

connected between ground and the other
strand of the cord-circuit during ringing, the
return-path for the current being over said
first-named strand and through the battery
5 to ground to avoid opening said local circuit
and thereby deenergizing said relays, and a
parallel branch closed by the ringing-key
around said supervisory relay during ringing

to prevent the same from chattering, sub-
stantially as described. 10

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

WILLIAM W. DEAN.

Witnesses:

LEROY D. KELLOGG,

KEMPSTER B. MILLER.