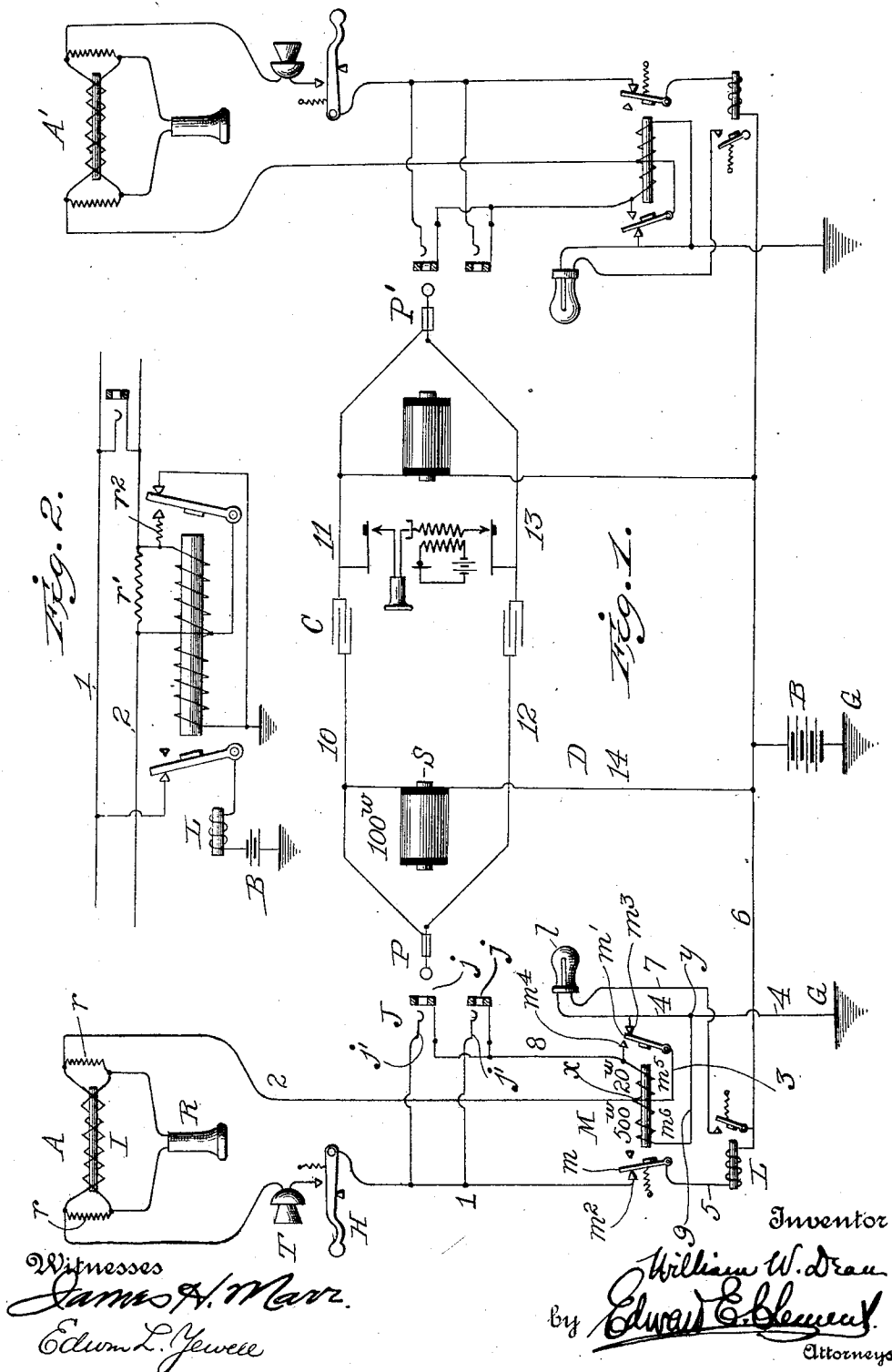


W. W. DEAN.
 TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED AUG. 8, 1904.

1,044,865.

Patented Nov. 19, 1912.



UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

1,044,865.

Specification of Letters Patent.

Patented Nov. 19, 1912.

Application filed August 8, 1904. Serial No. 220,030.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone systems, and has for its object the production of a system of this kind that will be certain in operation, simple to construct, and economical both in first cost of installation and for maintenance.

It relates particularly to systems of common battery type, wherein it is customary to employ relays at the central office controlling line signals to indicate the calls of the subscribers and for other purposes; and other relays entitled cut-off relays to remove the first named relays or the signals they control from operative connection with the lines during certain periods in operation. In many systems simplicity has been sought at the expense of certainty by using associated relays which work upon marginal differences in current. In other systems certainty has been attained at the expense of simplicity by using cut-off relays in separate local circuits, requiring separate and additional conductors for line and cord circuits. I avoid both of these by my present arrangement attaining in fact both simplicity and certainty, and without working on margins.

Briefly stated, my system comprises the usual circuit closing means at the subscribers' stations, metallic circuits extending to the central office, and a pair of relays for each line, one connected to each side of the line, the first a line signal relay and the second a cut-off relay. The first relay is a plain simple instrument of any suitable resistance connected to the line through one armature and its back contact of the cut-off relay. The cut-off relay on the other hand has two windings, which I shall describe as one of 20 ohms and the other of 500 ohms although these figures are purely arbitrary. The high winding is normally shunted, the number 2 side of the line being connected

directly to battery. The low side of the relay is connected between the number 2 side of the line and the jack-sleeves or thimbles. The jacks are plain two wire open multiples, each having a spring and sleeve connected to opposite sides of the line respectively. When a subscriber calls by taking down his receiver the circuit is closed, permitting current to flow through the line, and the line relay to light the signal lamp. The cut-off relay is not affected as its low winding is open and its high winding is shunted. When a plug is inserted in answer to its call, battery is connected through a low wound supervisory relay to the jack sleeve and thence through the low winding of the cut-off relay, a portion of the talking circuit being employed for the purpose. Current in the low winding pulls up the armatures of the cut-off relay and simultaneously breaks the shunt around the high winding. This becomes active, and at the same time the number 2 side of the line is connected around the low winding and directly to the jack sleeves. With this arrangement there is absolutely no resistance due to the cut-off relay normally in the line, but during conversation the relay is bridged, and this through its high winding, thereby preventing leakage.

In the accompanying drawing, in which Figure 1 is a diagram of the system embodying my invention, and Fig. 2 is a modification of the circuit, A is a subscriber's station and D is the central station. At the subscriber's station the usual apparatus is employed, comprising a receiver R, a transmitter T, a switch-hook H, a bridge coil I and balancing resistances $r-r$. The line wires 1-2 extend to the central office, where the former terminates at a back contact m^2 of the cut-off relay M, and the latter wire passes to a point x intermediate of the low winding m^5 and the high winding m^6 of the cut-off relay M. From this point the wire 2 is connected by wire 3 to the armature m' and thence through back contact m^3 and by wire 4 to ground and so to the main battery B. When the subscriber calls current passes over this circuit and energizes the relay L, the circuit being

traced as follows: B, 6, L, 5, m , m^2 , 1 H, T, I, $r-r$, 2, 3, m' , 4, ground, B.

The winding m^3 is connected by wire 8 to the jack sleeves j of the spring jacks J—J', etc. The high winding m^6 is connected by wire 9 to the wire 4 and thence on one side to ground and on the other side to the back contact m^3 , whereby the coil m^6 is normally shunted between the points $x-y$.

For interconnecting the lines I provide the usual cord circuits each having a pair of plugs P—P', and each having its conductors 10, 11, 12, 13, separated by the condensers C. Between the battery and the conductor 10 is the low wound supervisory relay S, similar relays being connected to such other portion of the cord as may be required but not being shown here as unnecessary to the explanation. The conductor 10, it will be noted, passes to the sleeve of the plug P, and when this plug is inserted in a jack, connection is established from battery B through wire 14 and relay S as follows: B, 14, S, 10, P, j , 8, m^5 , x , 3, m' , m^3 , 4, ground, and back to battery. This energizes relay M sufficiently to attract its armatures, and the very instant the armature m' leaves the contact m^3 the high winding of the relay is cut in by the breaking of the shunt 3. The relay then continues to hold up the two armatures m and m' , the former breaking the connection 5 to the line relay and thereby cutting the latter off.

The local circuit controlled by the relay L is shown at 7, containing a signal lamp 1, with a connection to the common wires 4 and 6 to the battery for current supply.

It will be noted that while normally there is no resistance between the relay L and the battery, when a connection exists with the line the cut-off relay is in a bridge to ground from the battery, but with a very high resistance and high impedance cut in to prevent leakage of the voice currents.

In the foregoing description I have referred to the cord circuit as having supervisory relays connected to it. This feature is also referred to in the claims hereafter. It should be understood that while I have shown only one relay, I intend to use the same cord circuit as that shown in a number of my previous cases, such for instance as Patent No. 758,623, this circuit being known as the "four-relay-cord circuit." There are two relays for each supervisory signal one closing the circuit thereof when a plug is inserted and the other opening the circuit thereof while the line is in use. Further description is unnecessary after reference to the above patent.

While I have described the two windings on the cut-off relay as high and low of five hundred ohms and twenty ohms respectively it should be understood that the relative resistances of these two windings are

immaterial, the principal point being that one winding is temporarily connected so as to be available for an operator who comes in on a jack, while neither winding is in the path of the signaling current when the subscriber is calling central. The only object in making one winding low is to save space on the core of the relay the low winding being usually made as a very short winding on one end of the core. It should be noted however that the windings must be tandem because if not and one should become short-circuited it would kill the impedance of the other.

In Fig. 2 of the drawing, which shows a modification of the circuit, I have shown two non-inductive shunts for the low resistance winding of the cut-off relay. Either one or both of these may be employed in order to put some current through the winding of the relay. The action of the relay would thereby become more certain.

It should be understood that I consider it broadly new with me to provide an absolutely clean signaling circuit and an absolutely clean talking circuit, and yet have the cut-off relay operated over the talking circuit so that only two wires are required into each jack. I shall therefore claim this broadly.

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

1. In a telephone system, the combination with a telephone line circuit, of a line-signal-controlling electromagnet and a source of current in the line circuit, a cut-off relay having a high resistance winding and a low resistance winding, the low winding normally connected with the line, and means to operate said cut-off relay to cut into circuit the high resistance winding, and to cut out of circuit the low resistance winding.

2. In a telephone system, the combination with a line circuit, of a cut-off relay having two windings either of which may be individually operative, but not both at the same time, a line signal controlling magnet and a battery therefor, and means to operate the cut-off relay to render the said magnet inoperative.

3. In a telephone system, the combination with a line circuit, of a cut-off relay having two windings, means for alternately rendering such windings ineffective, a line signal controlling electromagnet and a battery, said relay and electromagnet being connected in a branch or branches of the line circuit, and means to operate the cut-off relay to render the said electromagnet inoperative.

4. In a telephone system, the combination with a telephone line circuit, of a terminal therefor, a cut-off relay associated therewith having a high resistance winding and

a low resistance winding, said low resistance winding normally in operative condition with relation to the line and its terminal, and the high resistance winding normally disabled, a source of current in circuit with a line signal controlling electromagnet in a branch parallel to that of the cut-off relay, and means whereby the high resistance winding is rendered operative with respect to currents passing through the line and its terminal when connection is effected therewith, the two windings being thus interchanged when the cut-off relay is operated.

5. In a telephone system, the combination with a telephone line, of a line-signal-controlling electromagnet and a source of current in the line circuit, a cut-off relay having a high resistance and a low resistance winding, said low winding being normally connected in a branch of the line parallel to that of the signal electromagnet, and means to operate said cut-off relay to cut off the said electromagnet and to substitute the high resistance for the low resistance winding.

6. In a telephone system, the combination with a telephone line circuit, of a line-signal-controlling electromagnet and a source of current, a cut-off relay having a high resistance winding normally disconnected from the line for operative purposes, means to energize the core of said relay without using said high resistance winding, and means thereby made operative to cut in the high resistance winding, and to disable the line-signal-controlling electromagnet, said energizing means then becoming itself inoperative.

7. In a telephone system, the combination with a telephone line circuit of a line-signal-controlling electromagnet, a source of current, a cut-off relay having two windings, only one of which is normally in circuit, means to operate the cut-off relay to render the electromagnet inoperative and to cut in the other winding of the relay, together with means to cut out the first winding of the relay.

8. In a telephone system, the combination with a telephone line circuit of a line-signal-controlling electromagnet and a source of current, a cut-off relay having two windings in tandem on its core, one winding presenting considerable impedance for alternating currents and both windings normally out of the path of currents in the line, and being normally shunted, means brought into action through the agency of the second winding to render the first winding active, and means also to cut out the said line-signal-controlling electromagnet.

9. In a telephone system, the combination with a line circuit, of a line-signal-controlling electromagnet and a source of current normally connected to said circuit, a

cut-off relay having two windings one normally active and the other normally inactive, a cord circuit, and means actuated in connecting the cord circuit with the line to operate the cut-off relay through its active winding to cut in the other winding and thereby to cut off the said electromagnet and to render inactive the normally active winding.

10. In a telephone system, the combination with a line circuit, of a line-signal-controlling electromagnet and a source of current normally connected to said circuit, a cut-off relay having a high resistance winding and a low resistance winding, and an armature of said relay adapted to shunt the low resistance winding when the relay is energized.

11. In a telephone system, the combination with a line circuit, of a line-signal-controlling electromagnet and a source of current normally connected to said circuit, a cut-off relay having three sets of switch contacts, one of said sets being adapted to normally shunt a portion of the cut-off relay winding, another to complete the line circuit through the said electromagnet, and the third to shunt a second portion of the cut-off relay winding.

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

13. The combination with a telephone line, of a line signaling device and a source of current normally connected to the line, a cut-off relay having two windings, a connection from the line to a point intermediate of said windings, a connection terminal for the line, and means whereby one winding on the relay is normally included in the line circuit between said intermediate point and the connection terminal, together with means whereby upon making connection with the line the relay is actuated through said winding to remove the same from the path of current in the line and to cut off the said line signaling device, the second winding of the relay then becoming active to maintain the relay in its operative condition.

14. The combination with a telephone line, of a line signaling device and a source of current normally connected to one side of the line, a cut-off relay having a high resistance winding and a low resistance winding, a connection from the second side of

line to a point intermediate said windings and thence normally to the said source of current, a connection terminal for the line and means whereby the low resistance winding is normally included in the line between said intermediate point and the connection terminal, together with means becoming operative upon effecting connection with the line for conversation whereby the cut-off relay is actuated to disconnect the line signaling device and to connect the second side of line from said intermediate point direct to said connection terminal, without the interposition of said low resistance winding.

15 15. The combination with a telephone line, of a line signaling device and a source of current normally in the line, a cut-off relay for the line having a low resistance and a high resistance winding, the latter 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, to render the signal inoperative, and to close a shunt about the low resistance winding.

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 connected in series with the line signaling device but normally shunted to remove its resistance from the path of signaling current, and the low resistance winding normally included in series in the line, together with means to actuate the cut-off relay by means of the low resistance winding to break the shunt about the high resistance winding, to disconnect the line signaling device, and to remove the low resistance winding from the path of currents in the line.

17. 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 normally out of the path of current in the line when the subscriber is calling the central office, and means controlled at the central office to energize the relay through one winding and render it active for currents in the line to pass through the other winding.

18. The combination with a telephone line, of a signal controlling electromagnet in a multiple branch from one side of line, a cut-off relay having two windings connected to the other side of line one in a multiple branch thereof and the other in series therein, together with means normally shunting the multiple winding whereby its resistance is removed from the signaling circuit, said means adapted when the relay is energized to break the shunt about the multiple winding and complete a shunt about the series winding whereby the resistance

and impedance of the latter is removed from the line during conversation.

19. The combination with a telephone line, of a signal controlling electromagnet and a source of current in the line, a cut-off relay having two windings one in series with the signal controlling magnet and in multiple with the line, the other in series with the line but having no operative connection with the signaling circuit, both windings of said relay being inoperative for current in the line when the subscriber is calling the central office, an operator's cord circuit, and a local circuit containing the series winding of said relay adapted to be closed when the operator's circuit is connected with the line to operate the relay and render the signaling 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 having two windings, one winding in multiple with the line but unresponsive to current therein when the subscriber is calling the central office, the other winding normally in series with the line, a jack for the line, an operator's circuit and connecting plug, and a local circuit including the series winding adapted to be closed through registering contacts of the jack and plug upon the insertion of the latter into the jack in making a connection with the line, whereby said relay is operated to render the signaling magnet inoperative, to render the multiple winding of the relay operative, and to render the series winding of the relay inoperative and prevent its obstructing voice currents, substantially as described.

21. The combination with a telephone line, of a signal controlling electromagnet, a source of current and a cut-off relay all connected to the line, said relay having two windings one in the signaling circuit which is shunted while the subscriber is calling central, and the other in the talking circuit which becomes shunted in making connection with the line for conversation, substantially as described.

22. The combination with a telephone line, of a signal controlling electromagnet, a source of current and a cut-off relay connected to the line, said relay being normally shunted as regards direct current when a subscriber is calling central, but having an operative connection at such time with the line connection terminal, and being shunted as regards said terminal connection during conversation, together with means to actuate the relay over said connection to render the signal controlling electromagnet inoperative.

23. The combination with a telephone line, of a signal controlling electromagnet and a

source of current connected to the line, a cut-off relay, one winding of said relay, normally out of the path of current flowing in the line but adapted to be included therein when the relay is actuated, a second winding for said relay normally in the line, said relay being inoperative and offering no resistance to current in the line when a subscriber is calling the central office, and a local circuit established through said normally connected winding when a connection is made with the line to direct an operative current therethrough, substantially as described.

24. The combination with a telephone line, of a signal controlling electromagnet and a source of current in the line, a cut-off relay one winding of which is normally out of but adapted to be brought into the path of current flowing in the line, a second winding for said relay normally in but adapted to be put out of the path of current in a portion of the line, and means for sending an operating current through said last-mentioned winding in initiating a connection and thereafter, through the first-mentioned winding, excluding the other, substantially as described.

25. The combination with a telephone line, of a signal controlling electromagnet and a source of current in the line, a cut-off relay having two windings respectively in series and in multiple with the line, 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.

26. The combination with a telephone line, of a signal controlling electromagnet, a source of current and a cut-off relay all connected to the line, said relay having two windings included respectively in the branch of the signal controlling magnet and in the branch extension of the line to the jacks, the relay 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.

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 in the path of current flowing in the line, but normally shunted by a low resistance branch, a second winding for said relay, the

relay being inoperative for current in the line when a subscriber is calling the central office, means for operating the relay through the second winding when connection is effected with the line, and thereafter for shunting said second winding so as to leave the talking circuit clear, at the same time breaking the shunt of the first winding so as to maintain the relay energized 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.

28. In a telephone system, the combination with a subscriber's line having conductors normally extending to opposite poles of a source of current, each of said conductors also branched to a normally open jack terminal, of a signal controlling electromagnet and a switch between one line conductor and battery, with a cut-off relay having two windings connected in the two branches respectively of the second line conductor, and controlling said switch, substantially as described.

29. 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, one winding connected to the other conductor but normally inoperative, the circuit normally completed being used for signaling into the central station, and the second winding of the relay being included in an extension of one of the conductors to the connection terminals, said relay serving to control the continuity of the first named conductor, with means to send an operative current through a connection terminal and the second winding of the relay to cause it to open the signaling conductor when a connection is established with the line, substantially as described.

30. 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 side of the line, and a cut-off relay having two windings, one winding connected to the other side of the line as normally used for signaling in to central but normally inoperative and the other winding in an extension of the line to the connection terminal, said relay controlling the continuity of said normal signaling circuit, and having its second winding energized over a portion of the talking circuit when a connection is established with the line to render the signal controlling electromagnet inoperative and its own first winding operative, substantially as described.

31. The combination with a telephone line, of a line signal and a cut-off relay hav-

ing two windings and a source of current connected to the line, the cut-off relay being out of the path of 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 portion of the talking circuit when the cord circuit is connected with the line, means controlled by the subscriber for rendering said signal inoperative by current passing over the line circuit, and means controlled by the operator to energize the cut-off relay through one winding to place its other winding in the path of line currents during conversation, substantially as described.

32. 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 high resistance winding being connected to the line in the path of current when the subscriber is calling the central office, but temporarily shunted, connection terminals for the line permanently connected therewith, a cord circuit to establish a connection with the connection terminals, and means to operate the cut-off relay through its low winding to cut into circuit the high resistance winding of the same when the cord circuit is connected with one of the connection terminals and at the same time to remove the low winding from the path of talking current, substantially as described.

33. The combination with a telephone line, of a plurality of connection terminals therefor connected with the line, a cut-off relay and a battery connected to the line, said cut-off relay having a low resistance winding and a high resistance winding, the latter being normally shunted and the former adapted to be shunted during conversation, a cord circuit, a branch therefrom to 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 winding, to close the shunt around the low resistance winding, and to render the signaling device inoperative, and a supervisory signal associated with the cord circuit and controlled jointly by current in said local circuit and over the telephone line as opened and closed by the subscriber's telephone in use, said battery also serving to furnish current for talking purposes, substantially as described.

34. The combination with a telephone line, of a signal controlling electromagnet and a source of current connected to the line, a cut-off relay having two alternately active windings, said relay being normally

disabled for current in the line when the subscriber is calling the central office, a jack for the line connected therewith, and a local circuit including one winding of the 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, and its own windings are at the same time reversed as to their relative conditions, substantially as described.

35. The combination with a telephone line, of a plurality of connecting jacks for the line, a cut-off relay having two windings both normally entirely out of the path of currents in the line, but one operatively connected to the jack, 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 from said battery through that one of said windings which is connected to the jack over a circuit composed in part of a portion of the talking circuit when connection is established with one of said jacks, substantially as described.

36. The combination with a telephone line, and a connection terminal therefor of a signal controlling electromagnet normally connected with said line, a relay for disconnecting said electromagnet from the line said relay having two windings, one principal winding normally out of operative connection with either the line or connection terminals and the other subsidiary winding normally in connection with the connection terminal but not the line, a cord circuit terminating in a connecting plug and adapted to be placed in conductive relation with the line, a source of electricity associated with the cord circuit and adapted to be placed in the metallic circuit of the line, and means for closing the circuit of said source through the subsidiary winding of said relay when connection is made with the line, said relay circuit including a talking strand of the cord circuit, a main terminal of the connecting plug, a line contact and a portion of a talking limb of the telephone line with suitable return, substantially as described.

37. The combination with a telephone line, of line contacts therefor, a signal controlling electromagnet normally connected therewith, a relay for disconnecting said electromagnet from the line, a cord circuit terminating in a connecting plug, and means for closing circuit through a portion of the winding of said relay through a talking strand of the cord circuit, a main terminal of the connecting plug and a line contact of the telephone line, with means to remove said winding entirely from the talking circuit.

cuit when the relay is actuated, and to connect the other winding operatively therewith, substantially as described.

38. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a plurality of switching terminals thereat, a source of current at the central office, a testing contact for each of said switching terminals, an operator's testing instrument provided with a testing terminal having normally no effective difference in potential from that of the normal potential of the said testing contacts, a magnet and an associated line signal normally under the control of the subscriber, an electromagnet having two energizing windings the first winding being normally short-circuited and the second winding being normally included in circuit with one limb of the line, means under the control of the operator for causing the energization of the electromagnet and switching mechanism associated with said electromagnet adapted upon its energization to remove the said second winding from the direct line circuit.

39. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a plurality of switching terminals, a source of current at the central office, a testing contact for each of said switching terminals, an operator's testing terminal having normally no effective difference in electrical potential from that of the normal potential of the said testing contacts, a test-receiving instrument adapted to respond to an effective difference of potential between the said testing terminal and testing contacts produced through the establishment of a connection with said line, a magnet and an associated line signal normally under the control of the subscriber, an electromagnet having two energizing windings the first winding being normally short-circuited and the second winding being normally connected with one limb of the line in a circuit not under control of the subscriber, means under control of the operator for causing the energization of the electromagnet and switching mechanism associated with said electromagnet adapted upon its energization to include the said first winding in branch circuit of the line.

40. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a plurality of switching terminals, a source of current at the central office, a testing contact for each of said switching terminals, an operator's testing terminal having normally no effective difference in electrical potential from that of the normal potential of the said testing con-

tacts, a test receiving instrument adapted to respond to an effective difference of potential between the said testing terminal and testing contacts produced through the establishment of a connection with said line, a magnet and an associated line signal normally under the control of the subscriber, an electromagnet having two energizing windings the first winding being normally short-circuited and the second winding being normally included in circuit with one limb of the line, means under the control of the operator for causing the energization of the electromagnet and switching mechanism associated with said electromagnet adapted upon its energization to remove the said second winding from the direct line circuit and to include the said first winding in branch circuit of the line.

41. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided with a plurality of switching terminals thereat, a source of current at the central office, a testing contact for each of said switching terminals, an operator's testing instrument provided with a testing terminal having normally no effective difference in potential from that of the normal potential of the said testing contacts, a magnet and an associated line signal normally under the control of the subscriber, an electromagnet having two energizing windings the first winding being normally short-circuited and the second winding being normally included in circuit with one limb of the line, means under control of the operator for causing the energization of the electromagnet, switching mechanism associated with said electromagnet adapted upon its energization to remove the said second winding from the direct line circuit and to include the said first winding in branch circuit of the line, and switching mechanism adapted to destroy the substation control of the line signal.

42. In a telephone exchange system, the combination with a telephone line connecting a substation with the central office and provided thereat with a plurality of switching terminals, a source of current at the central office, a testing contact for each of said switching terminals, an operator's testing terminal having normally no effective difference in electrical potential from that of the normal potential of the said testing contacts, a test-receiving instrument adapted to respond to an effective difference of potential between the said testing terminal and testing contacts produced through the establishment of a connection with said line, a magnet and an associated line signal normally under the control of the subscriber, an electromagnet having two energizing windings the first

winding being normally short circuited and the second winding being normally included in direct circuit of the line between the source of current and the switching terminals, means under control of the operator
5 for causing the energization of the electromagnet and switching mechanism associated with said electromagnet adapted upon its

energization to remove the said second winding from the direct line-circuit. 10

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:

RAY H. MANSON,
S. A. BEYLAND.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."