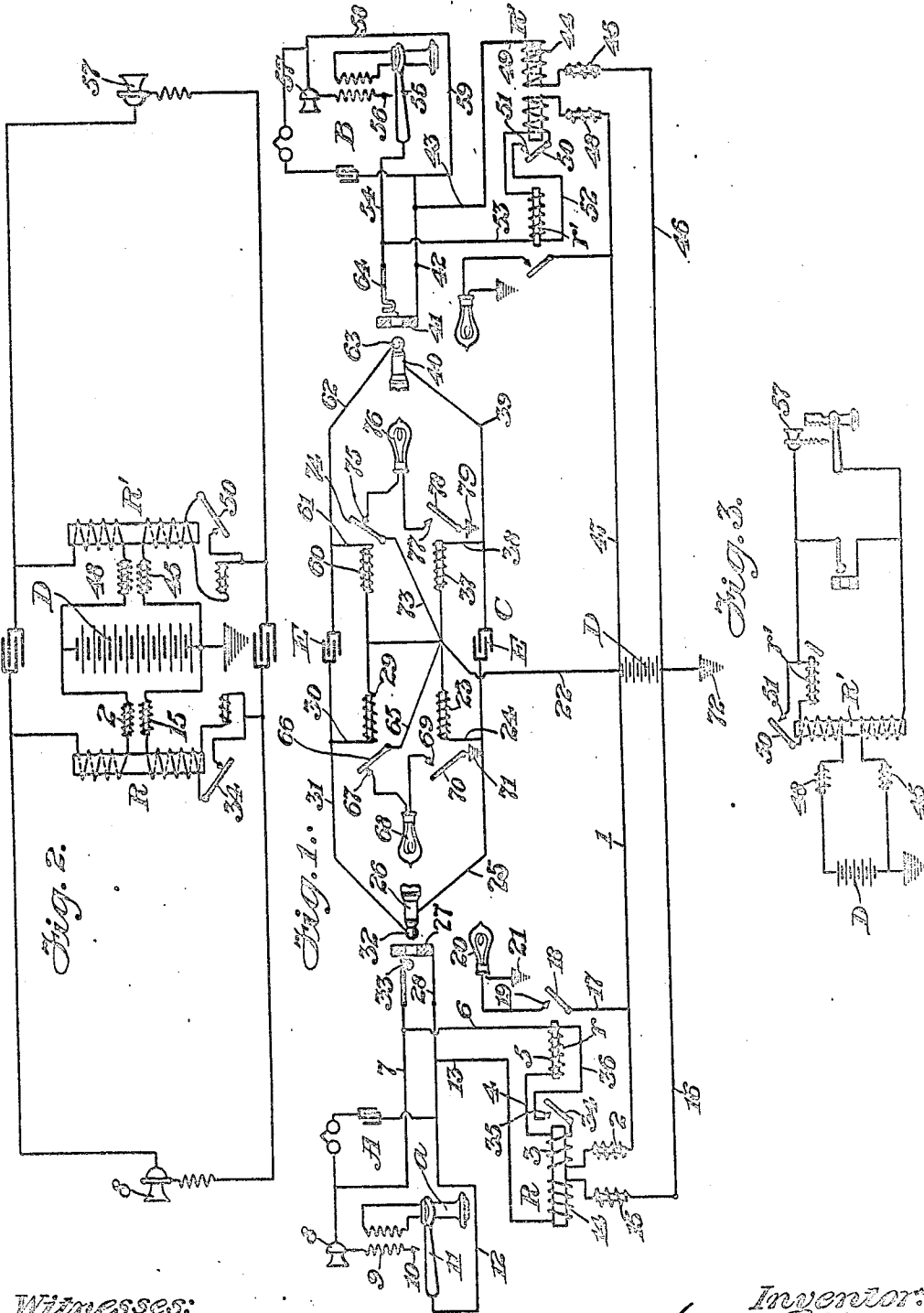


H. P. CLAUSEN.
TELEPHONE SYSTEM.

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1,044,748.



Witnesses:
Arthur F. Danand
Harry B. Baumgarten

Inventor:
Harry P. Clausen
By Charles R. Buehler, atty.

UNITED STATES PATENT OFFICE.

HENRY P. CLAUSEN, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER,
NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HENRY P. CLAUSEN, a citizen of the United States of America, and resident of Chicago, Cook county, Illinois, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems of that class in which the current for both talking and signaling purposes is supplied from a battery located at an exchange or central station. In a system of this character, a line or calling signal is associated with each line terminal at the central station. In addition to these, the central operator is provided with supervisory or clearing-out signals. It is also customary to associate a battery with the switchboard apparatus at the central station. The circuit arrangements are such that the current from this battery is employed not only for operating the microphone transmitters at the substations, but also for operating the signaling devices at the central station. An exchange or central station involving a switchboard apparatus or circuit arrangement of this character is ordinarily known as a common battery exchange.

Generally stated, the object of my invention is to provide a simple and efficient telephone system of the foregoing character.

A special object is to provide an improved arrangement of circuits and relays for operating the line or calling signals.

Another object is to provide an improved arrangement of circuits and impedance coils for supplying current directly to the lines.

A further object is to provide an improved arrangement of circuits and relays for operating the supervisory or clearing-out signals.

In addition to these, it is also an object to provide certain details and features of improvement tending to increase the general efficiency and to render a telephone system of this type more serviceable and reliable in use.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings, Figure 1 is a diagram illustrating a telephone system

embodying the principles of my invention. In this figure, two substations are shown connected with a central station, and a cord-circuit is shown at the latter station for establishing connection between the spring jacks of the two lines. It will be readily understood that only such instruments, devices and circuit connections are shown as are necessary to a full understanding of the invention. Fig. 2 is a simplified diagram of the circuit arrangement shown in Fig. 1, illustrating the method of supplying current directly to the subscribers' lines. Fig. 3 is a simplified diagram of the circuit arrangement for the line relays employed for operating one of the line signals, shown in Fig. 1.

As thus illustrated, and assuming that the subscriber at substation A desires connection with the subscriber at substation B, the operations and circuit connections which then take place are as follows. When the receiver *a* is lifted from the hook-switch at substation A, a line circuit is completed from the common or centralized battery D, through the battery lead 1, through the impedance coil 2, through the coil 3 of the differential line relay R, thence through the conductor 4, thence through the coil 5 of the supplemental line relay *r*, through the conductor 6, through the limb or line conductor 7, through the subscriber's transmitter 8, through the primary 9 of the induction coil, through the contact-point 10, thence through the hook-switch 11, through the other line conductor 12, through the conductor 13, through the other coil 14 of the said differential relay, thence through the impedance coil 15 and through the battery lead 16 to said battery. The current flowing through this completed line circuit energizes the supplemental relay *r*, but, owing to the differential winding, does not energize the relay R. The supplemental relay *r*, now energized, attracts its armature and completes a short local circuit through the battery D, through the conductors 1 and 17, thence through the armature 18 and the contact-point 19, through the line lamp 20, thence through the ground or common connections 21 and 22 to said battery. The current flowing through this local circuit is sufficient to

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cause the lamp 20 to glow, thereby attracting the attention of the central operator and indicating that the subscriber at substation A desires to give an order for connection. Observing this signal the central operator then inserts the answering plug of the cord-circuit in the jack corresponding to the line of the substation A. This act, it will be seen, operates to close a local circuit from the battery D, through the conductor 22, thence through the coil of supervisory relay 23, through the conductor 24, thence through the talking strand 25 of the cord-circuit, through the sleeve contact 26 of said plug, through the sleeve contact or thimble 27 of said jack, through the conductor 28, through the conductor 13, through coil 14 of the differential relay, and thence through the impedance coil 15 and conductor 16 to said battery. In this way, the flow of current through the coil 14 has increased to an extent to energize the relay R, causing it to attract its armature. In addition to this, the insertion of the answering plug completes a line circuit from the battery D, through conductor 22 and the coil of the supervisory relay 29, thence through the conductor 30 and the talking strand 31 of the cord-circuit, through the plug contact 32 and the jack spring 33, thence through the line conductor 7 and the transmitter 8, through the coil 9 of the induction coil, through the contact-point 10 and the hook-switch 11, thence through the line conductor 12 and the conductor 13, through the coil 14 of the differential relay, thence through the impedance coil 15 and the conductor 16, to said battery. Thus, the current flowing through the coil 14 is further augmented, causing the differential relay R, as stated, to attract its armature. The said armature, when attracted, closes a shunt around the supplemental line relay r. This shunt, it will be seen, consists of the armature 34, contact-point 35, and the conductor 36, the current passing through this shunt, rather than through the coil of the said supplemental line relay. When short-circuited in this manner, the supplemental line relay r ceases to attract its armature, and the said armature being released in this manner opens the local circuit including the lamp 20. In this way, the insertion of the answering plug of the cord-circuit serves to automatically extinguish or restore the line signal. It will be seen that the passage of current, in the manner previously described, through the relays 23 and 29, causes these relays to attract their armatures, the relay 23 being energized by the current flowing through a local circuit including the sleeve contacts of the plug and jack, and the relay 29 being energized by the current flowing through a line circuit including the hook-switch at the substation. Consequently, as

will hereinafter more fully appear, the relay 29 is deenergized as soon as the subscriber hangs up the receiver, while the relay 23 is not deenergized until the operator withdraws the plug from the jack.

After receiving the order for the connection desired, it being understood that this can be accomplished in any well-known or approved manner, the operator then inserts the calling plug of the cord-circuit in the jack corresponding to the line of substation B. This, it will be observed, completes a local circuit from the battery D, through the conductor 22, through the coil of supervisory relay 37, thence through the conductor 38 and the talking strand 39 of the cord-circuit, through the sleeve contact 40 of the calling plug, through the sleeve or thimble 41 of the said jack, through the conductors 42 and 43, thence through the coil 44 of the differential relay R', thence through the impedance coil 45 and the conductor 46 to said battery. With current flowing through but one of these coils, it will be seen that the differential relay R' is energized to an extent to attract its armature. The act of inserting the calling plug completes another local circuit from the battery D, through the conductor 22, through the conductor 73, thence through the armature 74, through contact-point 75, through the supervisory lamp 76, through the contact-point 77 and the armature 78, the latter having been attracted by the energizing of the supervisory relay 37, and thence through the ground or common connections 79 and 72 to said battery. Thus the insertion of the calling plug causes the supervisory lamp 76 to glow. This lamp, as will be seen, continues to glow until the called subscriber responds to the call. When the called subscriber removes the receiver from the hook-switch at substation B, a line circuit is completed from the battery D, through conductor 22, through the coil of supervisory relay 60, through the conductor 61, through the talking strand 62 of the cord-circuit, through the plug tip 63, through the jack spring 64, thence through the line conductor 54 and the hook-switch 55, through the contact point 56 and the primary of the induction coil, thence through the subscriber's transmitter 57, through the conductor 58, through the limb or conductor 59 of the line, through the conductor 43, through the coil 44 of the differential line relay R', thence through the impedance coil 45, and the conductor 46 to said battery. In this way, as in the previous case, the flow of current through one coil of the differential line relay is augmented by the completion of the line circuit. The flow of current through this line-circuit energizes the relay 60, causing it to attract its armature, and to thereby open or break the local circuit through the supervisory lamp 76. Thus, as

stated, this lamp is extinguished by the called subscriber in answering the call. Both receivers being off the hook-switches at the two substations, the subscribers are now connected up for conversation. It will be seen that the talking circuit includes the conductors or limbs of the two subscribers' lines, the parallel tip and sleeve strands of the cord-circuit, together with the tip and sleeve contacts of the plugs and jacks. It will also be seen that the talking circuit includes the condensers E, which are located in the talking strands of the cord-circuit. When connected up the two lines receive current directly from the battery. The insertion of the calling plug in the called subscriber's jack having operated to energize the differential line relay R', causing it to attract its armature, the supplemental line relay r' does not become energized. This is for the reason, as in the previous case, that current is shunted around this line relay rather than allowed to pass through it. The said shunt around the line relay r' consists preferably, as in the previous case, of the armature 50, the contact-point 51, and the conductor 52. In this way, it will be seen that the line signal apparatus of one line is similar to the line signal apparatus of the other line, and that consequently either subscriber can send in a call in the manner first described.

When the subscribers have finished talking, the act of hanging up the receivers automatically signals the operator for disconnection. For example, the subscriber at substation A, in hanging up the receiver, opens the line circuit including supervisory relay 29, allowing the latter to release its armature. Said armature when released completes a local circuit from the battery D, through conductors 22 and 65, thence through the armature 66, contact-point 67, through the supervisory lamp 68 and the contact-point 69, thence through the armature 70 and the ground or common connections 71 and 72 to said battery. The current flowing through this local circuit causes the supervisory lamp 68 to glow, thereby attracting the attention of the central operator and indicating that the subscriber at substation A is ready to be disconnected. In a similar manner, when the subscriber at substation B hangs up the receiver, the line circuit including the supervisory relay 60 is opened, thereby allowing the armature 74 to fall back into its normal position against the resting contact 75. This closes the previously described local-circuit including the lamp 76, causing the latter to glow, and in this way advising the operator that the called subscriber is also ready to be disconnected. The double supervisory signal apparatus having given a signal for disconnection, the operator then withdraws both plugs from the two jacks, and the system is then

in its normal or disconnected condition, so far as the two subscribers shown and described are concerned.

Thus it will be seen that by my invention I provide a simple and efficient telephone system of the common battery type, and, furthermore, that the efficiency and various advantages are obtained in a circuit having two-way jacks and plugs. In this way, I provide an exceedingly simple and efficient two-way circuit. In addition, the coils of the differential relays serve as impedance for supplying current directly to the lines, and, as shown and described, further impedance or retardation can be obtained by employing the impedance coils 2, 15, 48, and 45. These impedance coils can, however, be employed or not, as the conditions may require, and, if desired, the coils of the differential relays can be made the sole means of impedance or retardation between the lines and the source of current. As another advantage, it will be seen that the line signals will not light up or glow as a result of accidentally grounding either side of a subscriber's line. The differentially wound electro-magnets not only serve as impedance for the current supply, but also as relays for automatically closing shunts around the line relays when the plugs are inserted in the jacks, so as to automatically restore the line signals.

I claim as my invention:

1. A telephone switchboard apparatus comprising a spring jack, a subscriber's line connected with said spring jack, an operator's cord-circuit provided with a plug adapted for insertion in said jack, a battery connected with the line, a line relay, a supplemental line relay, a shunt around said supplemental relay, a normally open switch-point in said shunt controlled by said line relay, a line lamp having a local circuit including said battery, and a normally open switch-point in said local circuit controlled by said supplemental line relay.

2. A telephone switch-board apparatus comprising a line signal, a relay for operating the line signal, means for supplying current through the coil of said relay, a normally open line shunt around said relay, and a line relay for closing said shunt.

3. In a telephone system, the combination of a subscriber's line, a relay having its coil in the line, means for supplying current to the line through the coil of said relay, a shunt permanently connected with the line and extending around said relay, a normally open switch-point in said shunt, a line signal operated by said relay, and a second relay for closing said switch-point.

4. In a telephone system, the combination of a subscriber's line, a differential line relay, a supplemental line relay, means for supplying current to the line through both

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the said relays, a shunt around said supplemental line relay, a normally open switch-point in said shunt controlled by said differential relay, and a line signal controlled by said supplemental line relay.

5. In a telephone system, the combination of a subscriber's line, a source of current, a differential relay having its coils arranged to serve as impedance or retardation through which current is supplied to the line, a spring jack connected with the line, an operator's cord-circuit provided with a plug adapted for insertion in said jack, a supplemental line relay, a line signal controlled by said supplemental line relay, a shunt around said supplemental line relay, a normally open switch-point in said shunt controlled by said differential line relay, and suitable connections whereby the insertion of said plug in said jack causes the differential relay to close said shunt, so as to restore the said signal.

6. In a telephone system, the combination of a subscriber's line, a battery connected with each side of the line, a differential relay having its coils connected in opposite sides of the line, impedance coils interposed between the said differential relay and said battery, a supplemental line relay connected between one side of the line and one of the differential relay coils, a shunt around said supplemental line relay, a normally open switch-point in said shunt controlled by said differential relay, a line lamp having a local circuit including said battery, a normally open switch-point in said local circuit controlled by said supplemental relay, and suitable connections for closing a local circuit through one coil of said differential relay, so as to cause the latter to close said shunt and thereby deenergize the supplemental relay and extinguish said lamp.

7. In a telephone system, the combination of a subscriber's line, a differential line relay, means for supplying current to the line through the coils of said differential line relay, a supplemental line relay, a line lamp having a local circuit including said battery, a normally open switch-point in said local-circuit controlled by said supplemental line relay, a shunt around said supplemental line relay, a normally open switch-point in said shunt controlled by said differential line relay, a spring jack connected with the line, an operator's cord-circuit provided with a plug adapted for insertion in said jack, a supervisory relay associated with the cord circuit, and suitable connections whereby the insertion of the plug in the jack operates to complete a local circuit through the said supervisory relay, and whereby the said local circuit includes one coil of said differential relay.

8. In a telephone system, the combination of a subscriber's line, a line signal, means

for supplying current, a line relay for causing the display of said signal, a normally open line shunt adapted to be closed for the purpose of deenergizing said line relay, and a differential relay connected and arranged to control said shunt.

9. In a telephone system, the combination of a subscriber's line, a line signal, a suitable source of current, a normally open line shunt adapted to be closed to effect the restoration of said signal, means about which the shunt is closed and a differential relay connected and arranged to control said shunt.

10. In a telephone system, the combination of a subscriber's line, a line signal, a suitable source of current, suitable connections and circuit closing devices for causing the display of said signal, a normally open line shunt and a differential relay connected in the line and arranged to control said shunt, the latter when closed causing the restoration of said signal, and means about which the shunt is closed.

11. In a telephone system, the combination of a subscriber's line, a two-way jack connected with the line, an operator's cord-circuit provided with a two-way plug adapted for insertion in said jack, a source of current permanently connected with the line, a differential line relay through which current is supplied to the line, a supplemental line relay having its coil arranged to serve as medium of electrical connection between one coil of the differential relay and the tip side of the line, a shunt around said supplemental line relay, a normally open switch-point in said shunt controlled by said differential relay, a supervisory relay associated with the cord-circuit, a line lamp having a local circuit including said source of current, a normally open switch-point in the circuit of said lamp controlled by said supplemental relay, and suitable connections whereby the insertion of the plug in the jack completes a local-circuit including the supervisory relay and one coil of the differential relay, and also including the sleeve contacts of the plug and jack.

12. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line circuit, a two-way jack connected with the line, an operator's cord-circuit provided with a two-way plug adapted for insertion in said jack, a suitable source of current permanently connected with the line, a differential line relay through which current is supplied to the line, a supplemental line relay connected between one coil of the differential relay and the tip side of the line, a shunt around said supplemental relay, a normally open switch-point in said shunt controlled by said differential relay, a supervisory relay connected between the source of current

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and the tip strand of said cord-circuit, a second supervisory relay connected between the source of current and the sleeve strand of the cord-circuit, a line signal controlled by said supplemental relay, and suitable connections whereby the insertion of the plug in the jack completes a local circuit including the second supervisory relay and one coil of the differential relay, and also including the sleeve contacts of the plug and jack.

13. In a telephone system, the combination of a subscriber's line, a line signal associated with the line, a source of current permanently connected with the line, a differential line relay and a supplemental line relay, a normally open shunt adapted and arranged to cooperate in controlling said line signal, a supervisory relay, a normally open line circuit including one coil of the differential relay and also the coil of the supervisory relay, and a subscriber's hook-switch also included in the said line circuit.

14. In a telephone system, the combination of a subscriber's line, a two-way jack, a cord-circuit having a two-way plug adapted for insertion in said jack, a suitable line signal, a suitable source of current, a shunt permanently connected in the line and means controlled thereby for effecting the restoration of said signal, a normally open switch-point in said shunt, and a relay for controlling said switch-point.

15. In a telephone system, the combination of a complete metallic line circuit, a differential relay having its windings included in opposite sides of said circuit, a line signal, a line relay for operating said signal, a normally open shunt around said line relay, said shunt being controlled by said differential relay, an operator's cord circuit adapted to be connected with the said line circuit, a battery included in the line circuit and connected with the cord circuit, and suitable connections for including one strand of the cord circuit and one winding of said differential relay in a local circuit.

16. In a telephone system, the combination of a metallic line circuit, a differential relay having its windings included in opposite sides of said line circuit, a line signal, a line relay for operating said signal, a normally open shunt around said line relay controlled by said differential relay, an operator's cord circuit adapted to be connected with the line circuit, a supervisory relay and a supervisory signal associated with the cord circuit, a battery included in the line circuit and connected with the cord circuit, the connections being such that the said supervisory relay and one winding of the said differential relay are included in a local circuit when the operator's cord circuit is connected with the line.

17. In a telephone system, the combination of a line circuit, a differential relay having its coils included in opposite sides of said circuit, an operator's cord circuit adapted to be connected with the said line circuit, a battery in the line circuit and connected with the cord circuit, a supervisory relay and suitable connections for including one strand of the cord circuit, the supervisory relay, and one winding of said differential relay in a local circuit.

18. In a telephone system, the combination of suitable connections forming a talking circuit, a condenser in each side of the circuit, and means for supplying current to the circuit at each side of said condensers, differential relays having coils through which the current is supplied to the circuit, impedance coils interposed between the circuit supply and the coils of said relays, suitable line signals adapted to be restored to normal by said relays, and supervisory relays each adapted to be included in local circuit with one winding of a differential relay.

19. In a telephone system, the combination of suitable connections forming a talking circuit, a condenser in each side of the circuit, means for supplying current to the circuit at points each side of said condensers, differential relays having coils through which current is supplied to the talking circuit, line signals adapted to be restored to normal by said differential relays, and supervisory relays each adapted to be included in local circuit with one winding of a differential relay.

20. In a telephone system, the combination of a subscriber's line, a suitable line signal, a suitable source of current supply, suitable connections and circuit closing devices for causing the display of said signal, a differential line relay connected and arranged to cause the restoration of said signal, and a supervisory relay adapted to be included in local circuit with a portion of the talking circuit and one winding of said differential relay.

21. A telephone system comprising a subscriber's line, suitable line signal apparatus, a differential relay for restoring the line signal to normal, a centralized source of current adapted to supply current to the line through the winding of said differential relay for both talking and signaling purposes, a pair of supervisory relays, a plug switch for controlling one of said supervisory relays, a subscriber's switch adapted to control the other supervisory relay when said plug switch is closed, and a supervisory signal controlled conjointly by said supervisory relays.

22. A telephone system comprising a subscriber's line, suitable line signal apparatus, a non-sensitive relay in the line circuit for

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restoring the line signal to normal, a source of current connected with the line through the medium of the winding of said non-sensitive relay, a pair of electro-magnets, a plug switch for controlling both the non-sensitive relay and one of said electro-magnets, a subscriber's switch for controlling the other electro-magnet when said plug switch is closed, and a supervisory signal controlled conjointly by said electro-magnets.

23. A telephone system comprising a subscriber's line, a centralized source of current connected with the line, suitable line signal apparatus, and means including a non-sensitive relay in the line circuit and a normally open shunt circuit controlled by said relay for restoring the line signal to normal.

24. A telephone system comprising a non-sensitive relay in the line, a supervisory relay in the cord circuit, and a plug switch for connecting a winding of each relay in series with a battery and a portion of one side of the talking circuit.

25. In a telephone system, the combination with a telephone line, of a central source of current, a line relay normally interposed between one of the limbs of said line and one terminal of said source, a line signal adapted to be displayed by the actuation of said line relay, a cut-off relay also associated with the line and adapted by its actuation to shunt said line relay to efface said signal.

26. In a telephone system, the combination with a telephone line, of a line and a cut-off relay for said line, a source of current at the central office to furnish energy for the actuation of said relays, and means whereby the actuation of said cut-off relay places a shunt around the coil of said line relay to prevent its actuation.

27. In a telephone system, the combination with a telephone line, of a central source of current, a signaling device for the line normally in series with said line and source, a cut-off relay associated with the line and adapted by its actuation to shunt said line signaling device to render the same inoperative.

28. In a telephone system, the combination with telephone lines, of a central source of current with which the lines are normally connected, a line signaling device for each line, a cut-off relay for each line, an operator's cord circuit to establish connections with the line for conversation, said cut-off relay being operated whenever the cord circuit is connected with the line over a circuit including a portion of the talking circuit, and a shunt circuit about the coil of said line signaling device closed by the operation of said cut-off relay to deprive said line signaling device of energizing current and thereby render the signal inert.

29. The combination with a telephone line, of a battery having both its poles permanently connected with a line and serving when desired to send current over the telephone line for the operation of its apparatus, a relay adapted to be included in a branch circuit completed when a connection is established with the line, a supervisory signaling device having the continuity of its circuit controlled at one point by said relay, and a line signal adapted to be retired by the closure of said branch circuit.

30. The combination with a telephone line, of a battery permanently connected in a bridge of the limbs of said line, a relay adapted to be included in a branch circuit at the central office completed when a connection is established with the line, said circuit including a portion of one line conductor and being charged by current from said battery, a supervisory signal having its circuit controlled at one point by said relay, and a line signal adapted to be retired by the closure of said branch circuit.

31. The combination with a telephone line, of a battery permanently connected in a bridge of the limbs of said line, a cord circuit, a relay connected with a strand of the cord circuit and the battery, whereby when a connection is made with the line a branch circuit is completed for said relay including the relay conductor, the cord strand and a portion of one line conductor, and receiving current from said battery, a supervisory signal placed in operative condition by the actuation of said relay, and a line signal adapted to be retired by the closure of said branch circuit.

32. The combination with a telephone line, of a line relay in one conductor of the line, a battery permanently connected between said conductor and the other conductor, a cord circuit, a relay connected therewith and with the battery, means for including said relay in a branch circuit comprising its conductor, the cord circuit, and a portion of said other line conductor, said circuit being charged by current from said battery, and a line signal adapted to be retired by the closure of said branch circuit.

33. The combination with a telephone line, of a battery permanently connected in a bridge of the limbs of said line, a cord circuit and a pair of supervisory relays bridged across the line when connection is established by the cord circuit with the line, one of said relays being in a path for current supplied for charging the transmitter at the substation of the line and the other relay being in a branch circuit closed when connection is made with the line, a supervisory signal jointly controlled by said relays, and a line signal adapted to be retired by the closure of said branch circuit.

34. The combination with a telephone

line, of a battery permanently connected in a bridge of the limbs of said line at the central office, a cord circuit, supervisory relays connected between the cord circuit and the battery, means for including one of said relays in a circuit from the battery when a connection is established with the line, said circuit including a telephone line to the substation whereby said relay is placed under control of the subscriber, means for including the other relay in a branch circuit whereby said relay is energized as soon as the connection is established, a supervisory signal having its circuit controlled by said relays, and a line signal adapted to be retired by the closure of said branch circuit.

35. The combination with a telephone line, of a battery having both its poles permanently connected with a line and serving when desired to send current over the telephone line for the operation of its apparatus, a relay excluded from the talking circuit adapted to be included in a branch circuit completed when a connection is established with the line, a supervisory signaling device having the continuity of its circuit controlled at one point by said relay, and a cut-off relay adapted to be energized over said branch circuit.

36. The combination with a telephone line, of a line relay permanently included in one conductor of the line, a battery permanently connected between said conductor and the other conductor, a cord circuit, a relay connected therewith and with the battery, and means for including said relay in a branch circuit comprising its conductor, the cord circuit, a portion of said other line conductor, said circuit being charged by current from said battery, and a cut-off relay adapted to be energized over said branch circuit.

37. The combination with a telephone line, of a battery permanently connected in a bridge of the limbs of said line, a cord circuit and a pair of supervisory relays bridged across the line when connection is established by the cord circuit with the line, one of said relays being in a path for current supplied for charging the transmitter at the substation of the line and the other relay being in a branch circuit closed when connection is made with the line, a supervisory signal jointly controlled by said relays, and a cut-off relay adapted to be energized over said branch circuit.

38. The combination with a telephone line, of a battery permanently connected in a bridge of the limbs of said line at the central office, a cord circuit, supervisory relays connected between the cord circuit and the battery, means for including one of said relays in a circuit from the battery when a connection is established with the line, said circuit including a telephone line to the sub-

station whereby said relay is placed under control of the subscriber, and means for including the other relay in a branch circuit whereby said relay is energized as soon as the connection is established, a supervisory signal having its circuit controlled by said relays, and a cut-off relay adapted to be energized over said branch circuit.

39. The combination with a calling telephone line, of a battery permanently connected in a bridge of the limbs of said line, a cord circuit, a relay connected with a strand of the cord circuit and the battery, whereby when a connection is made with the calling line a branch circuit is completed for said relay including the relay conductor, the cord strand and a portion of one line conductor, and receiving current from said battery, a supervisory signal placed in operative condition by the actuation of said relay, a called line connected with the calling line, and a similar relay connected with the called line.

40. The combination with a calling telephone line, of a line relay permanently included in one conductor of the line, a battery permanently conducted between said conductor and the other conductor, a cord circuit, a supervisory relay connected therewith and with the battery and excluded from the path of voice currents, means for including said supervisory relay in a branch circuit comprising its conductor, the cord circuit and a portion of said other line conductor, said circuit being charged by current from said battery, a called line connected with the calling line, and a similar supervisory relay connected with the called line.

41. The combination with a calling telephone line, of a battery permanently connected in a bridge of the limbs of said line, a cord circuit and a pair of supervisory relays bridged across the line when connection is established by the cord circuit with the line, one of said relays being in a path for current supplied for charging the transmitter at the substation of the calling line, and the other relay being in a branch circuit closed when connection is made with the said line, a supervisory signal jointly controlled by said relays, a called line connected with the calling line, and a similar pair of relays connected with the called line.

42. The combination with a calling telephone line, of a battery permanently connected in a bridge of the limbs of said line at the central office, a cord circuit, supervisory relays connected between the cord circuit and the battery, means for including one of said relays in a circuit from the battery when a connection is established with the line, said circuit including a telephone line to the calling substation, whereby said relay is placed under control of the calling subscriber, means for including the other relay in a

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branch circuit, whereby said relay is energized as soon as the connection is established, a supervisory signal having its circuit controlled by said relays, a called line connected with the calling line, and a similar pair of relays connected with the called line.

43. In a telephone system, a cord circuit, two relays for one end of said cord circuit, one energized over a derived local circuit completed when connection is established with the calling line, the other energized over a line circuit including the substation of the calling line, two similar relays for the other end of said cord circuit, having a similar relation to the called line, a supervisory signal controlled by the first pair of relays, a supervisory signal controlled by the second pair of relays, and a battery having

both poles thereof permanently connected with the telephone lines.

44. In a telephone system, a cord circuit, two supervisory relays for one end of the cord circuit, two supervisory relays for the other end of the cord circuit, a supervisory signal controlled by one pair of relays, another supervisory signal controlled by the other pair of relays, a local circuit for one relay of each pair, and a battery having both poles thereof permanently connected with the telephone lines.

Signed by me at Chicago, Cook county, Illinois, this 16th day of April, 1902.
HENRY P. CLAUSEN.

Witnesses:

ARTHUR F. DURAND,
HARRY P. BAUMGARTNER.

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