

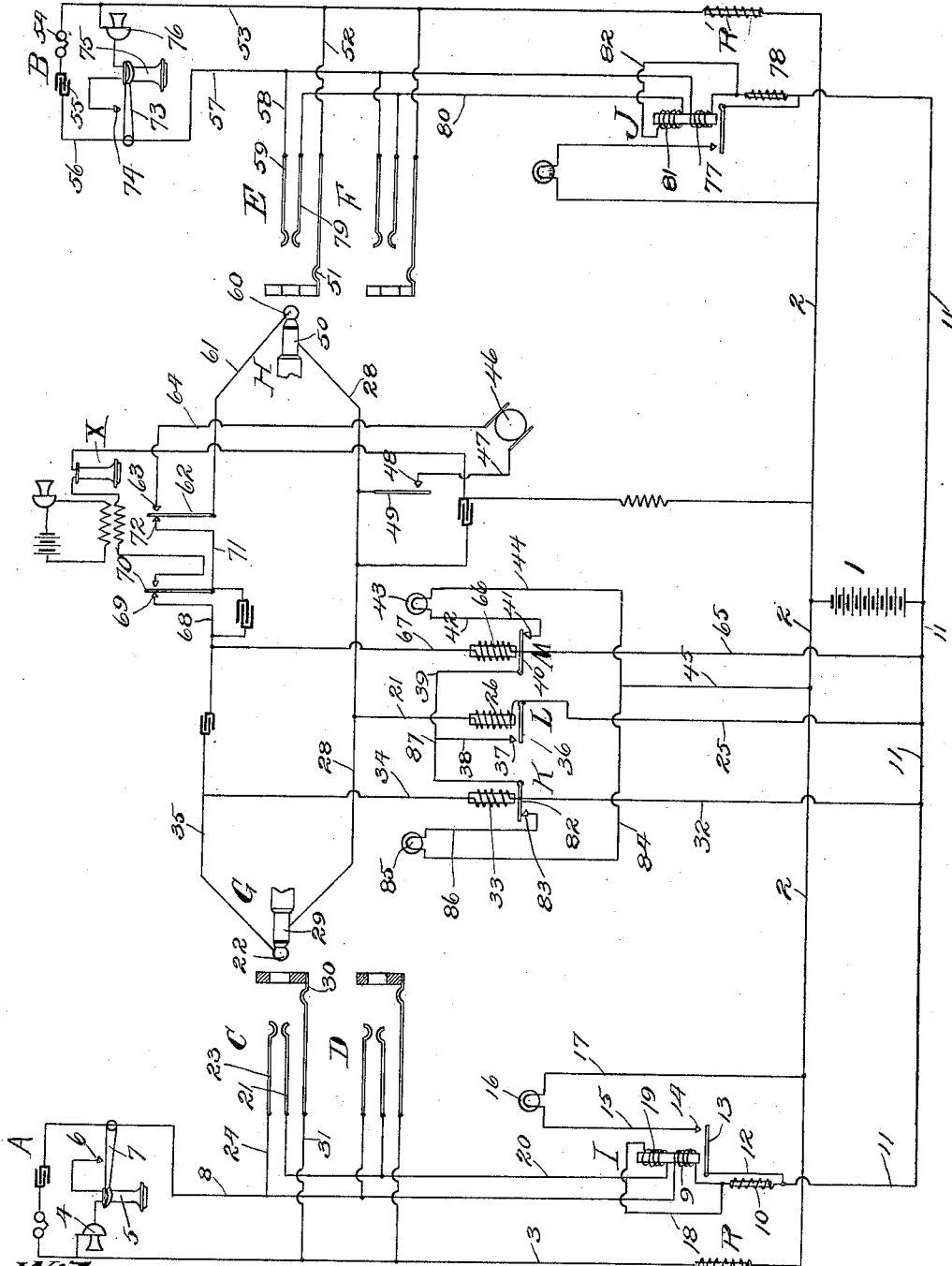
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TELEPHONE SYSTEM.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, DAVID L. TEMPLE and CHARLES L. GOODRUM, citizens of the United States, and residents of Chicago, county of Cook, and State of Illinois, and of Atlantic City, Atlantic county, and State of New Jersey, respectively, have invented a certain new and useful Improvement in Telephone Systems, of which the following is a specification.

Our invention relates to telephone systems in general, but more particularly to systems of the complete metallic and central energy type. In systems of this character complete metallic circuits are provided between the sub-stations and the central exchange, thereby avoiding the use of grounded circuits. It is also the practice to provide a central source of current supply, such, for example, as a battery located at the central exchange, and to supply current from this battery to the line for talking purposes, and also for operating the various signals. These signals usually consist of bells at the sub-stations by which the central operator may call up the subscribers, and of lamps, drops or other signal devices located at the central exchange. These signal devices which are thus located at the central exchange are for the purpose of enabling the subscribers to attract the attention of the central operator, and to thereby signal for either connection or disconnection. Consequently these signals at the exchange are of two kinds, to-wit: line or calling signals and supervisory or clearing out signals. By means of the calling signals each subscriber is enabled to call up the central exchange, and to communicate to the central operator that connection with some other subscriber is desired. By means of the supervisory signals each subscriber when through talking indicates to the central operator that the conversation is over and that a disconnection is desired. Generally stated, it is the object of our invention to provide a simple, satisfactory and highly efficient telephone system of the foregoing character.

A special object of our invention is to provide an improved circuit arrangement for operating the calling signals.

A further object is to provide an im-

proved circuit arrangement and apparatus for operating the supervisory signals.

Another object is to provide an improved circuit arrangement whereby the central operator may answer a call without producing objectionable sounds in the receiver at the sub-station.

Furthermore, it is a special object of our invention to provide a simplified and improved apparatus and circuit arrangement for either extinguishing or restoring the calling signals.

In addition to these, it is an object of our invention to provide an improved circuit arrangement by which substantially all of the advantages of other known or approved systems may be secured with considerably less apparatus, and particularly to provide an improved two-way cord circuit having practically all of the advantages of the usual three-way system. The nature and operation of our invention, together with certain other advantages, will, however, hereinafter more fully appear.

The accompanying drawing is a diagram, illustrating a telephone system embodying the principles of our invention. In this diagram it will be seen that only two sub-stations are shown, together with a cord circuit and line connections, and it will be understood that only such instruments and circuit connections are illustrated as are necessary to an understanding of our invention.

Thus illustrated, the system is in its normal condition, and comprises suitable subscriber's or substation apparatus, connected in the usual manner with the spring-jacks on the switch-board at the central station. The said switchboard also includes, it will be readily understood, the usual operator's connecting cords, only one of which is shown, and which are provided with plugs of the well known character for insertion in the jacks. Line signals are included, whereby the subscribers may call in or signal the operator; and supervisory signals, whereby the operator may receive the usual signals for disconnection, are also included in the cord circuit. The batteries shown at the central station, and connected as illustrated with the cord circuit and also with the subscribers' lines, are adapted to supply

current to the lines for both signaling and talking purposes. The various circuit connections, and the nature of the different devices employed will, however, be more clearly understood by considering the various connections and operations which take place in connecting up two subscribers for conversation and in then finally disconnecting two subscribers. Therefore, assuming that the subscriber at sub-station A desires to communicate with a subscriber at sub-station B, the operations and circuit connections which take place are as follows: When the subscriber at sub-station A takes down the receiver, a line circuit is immediately completed from battery 1 through the battery lead 2, through the retardation coil R, thence to line conductor 3, through the transmitter 4 and the receiver 5 to the contact point 6, from the latter through the switch-lever 7 to the line conductor 8, over the latter to the coil 9 of the differential relay I, thence through the retardation coil 10 and the battery lead 11 and back to the said battery. This energizes the differential relay I and causes the armature of the latter to close a short local circuit including the battery 1, the battery lead 11, the conductor 12, the armature 13 and the contact point 14, the conductor 15, lamp 16, the conductor 17, and also the other battery lead 2. This, it will be seen, lights the line lamp 16, and indicates to the central operator that the subscriber at sub-station A desires connection with sub-station B. The central operator, upon seeing this signal, inserts the answering plug G of the cord circuit into the jack C. The plug connection thus established completes another parallel line circuit from the battery 1 through the battery lead 11 and the retardation coil 10, thence from the conductor 18 and coil 19 of the differential relay I, through the conductor 20, through jack-spring 21 and plug tip 22, thence through jack-spring 23 and line 8 to the switch-lever 7, through contact point 6 and the receiver 5 to the transmitter 4, from the latter over the line conductor 3, thence through the retardation coil R and the battery lead 2 and back to said battery. This, it will be seen, operates to deenergize the differential relay I by reason of the differential winding of the latter, and to extinguish or restore the line signal 16. In addition to this, the insertion of the answering plug G in the jack also operates to complete a short local circuit from battery 1 through the battery lead 11 and the conductor 25 to the coil 26 of relay L, thence through the conductor 21 to the ring contact 29 of the answering plug G, through the testing ring 30 of jack C, thence through conductor 31 and line conductor 3 to retardation coil R, and from the latter through the battery lead 2 to said battery. It will also be seen that a

line circuit is completed from battery 1 through the battery lead 11 and the conductor 32 to relay K, through the relay coil 33 and the conductor 34 to cord strand 35, thence through the plug-tip 22 to jack-spring 23, through the conductor 24 and the line conductor 8 to switch-lever 7, thence through the contact point 6 and receiver 5 to transmitter 4, through the line conductor 3 to retardation coil R, thence through the battery lead 2 and back to the said battery.

The energizing of relay K lifts its armature away from the associate contact point, and in this way prevents the lighting up of the supervisory lamp allotted to the sub-station A. The energizing of relay L lifts its armature into contact with the associate contact point, thereby closing a short local circuit from the battery 1 through the battery lead 11 and the conductor 25 to the armature 36 of relay L, thence through contact point 37 and conductors 38 and 39 to armature 40, from the latter through contact point 41 and conductor 42 to supervisory lamp 43, thence through conductors 44 and 45 to battery lead 2, and thence to the said battery. This, it will be seen, operates to light the supervisory lamp 43, and, as will hereinafter more fully appear, this lamp remains lighted until the called for subscriber answers the call. At this point, it will be understood, the central operator presses the usual listening key, and in this way bridges the operator's talking set across the line in the usual and well known manner. Upon learning the number of the subscriber called for, the central operator inserts the calling plug H in the jack E, assuming that it is the line of sub-station B with which the subscriber at sub-station A desires connection. At this point the operator then presses the usual ringing key so as to bridge the usual ringing generator across the line in the usual manner, and so as to complete a line circuit from the generator 46 through conductor 47 and contact point 48 to ringing key 49, thence through cord strand 28 to the ring contact 50 of calling plug H, thence through the testing ring 51 of jack E, through conductor 52 and line conductor 53 to the bell 54 at sub-station B, thence through the condenser 55, conductor 56 to line conductor 57, through the latter and the conductor 58 to jack-spring 59, thence through plug-tip 60 and cord strand 61 to ringing key 62, through contact point 63 and back to the generator through conductor 64. The operation of the said generator causes the bell 54 to ring at sub-station B, thus attracting the attention of the subscriber at this station. During this signaling from the central exchange to the subscriber at sub-station B, the supervisory lamp 43 allotted to the line of this sub-station continues to burn, and this signal is dis-

played until the subscriber answers the call. When the call is answered and the receiver at sub-station B removed from its hook a line circuit is immediately completed from the battery 1 through the battery lead 11 and the conductor 65 to supervisory relay M, through the relay coil 66 and the conductor 67 to cord strand 68, thence through contact point 69 and the listening key 70 to ringing key 62, thence through cord strand 61 and plug-tip 60 to jack-spring 59, through conductor 58 and line conductor 57 to switch-lever 73, thence through contact point 74 and the receiver 75 to transmitter 76, thence through line conductor 53 and retardation coil R^1 to battery lead 2, and through the latter to the said battery. This, it will be seen, causes the relay M to lift its armature away from the associate contact point, thereby extinguishing or restoring the supervisory signal allotted to the sub-station B, and temporarily connected with the latter through the medium of the plug and jack. Another circuit is also completed from the battery 1 through the battery lead 2 and the retardation coil R^1 to line conductor 53, over the latter and through the transmitter 76 to the receiver 75, thence through contact point 74 and hook-switch 73 to the line 57, through the latter to the coil 77 of the differential relay J, thence through the retardation coil 78 and the lead 11 to the battery. Ordinarily this would cause the operation of the line signal allotted to sub-station B, but at this juncture it will be seen that another circuit is also completed from the battery 1 through the lead 2 and the retardation coil R^1 to the line conductor 53, thence through the transmitter 76 and receiver 75 to contact point 74, through the hook-switch 73 and line conductor 57 to conductor 58, thence through jack-spring 59 and plug tip 60 to jack-spring 79, through the conductor 80 to the coil 81 of the differential relay J, thence through conductor 82 and retardation coil 78 to battery lead 11, and then to the said battery. In this way both coils of the differential relay J are energized when the call is answered, and the differential winding causes one current to neutralize the other, so as to prevent the lifting of the armature, which closes the local circuit through the line lamp signal. Hence, as stated, the differential relay permits the call to be answered without operating the line signal.

With both plugs in the jacks of the respective sub-station lines, and with both receivers off the hooks, the two sub-stations are connected for talking purposes, the talking circuit comprising the lines and the strands of the cord circuit. With this arrangement and thus connected up, it will be seen that the subscribers are enabled to talk over a metallic circuit. It will also be seen

that the current is supplied directly to the line, rather than through the cord circuit and through suitably arranged retardation coils. It will be readily understood that what is known as the "busy" test can be made in the usual manner, as, for example, by touching the tip of the calling plug to the testing ring of the jack, so as to produce a click in the operator's receiver, or by inserting the plug in the jack and thus making the visual test by means of the supervisory lamp.

When the subscribers are through talking, and assuming that the subscriber at sub-station A then hangs up receiver 5, the operations and disconnections are as follows: The hanging up of receiver 5 of course breaks the line circuit, thereby deenergizing the supervisory relay K, and allowing the armature 82 to make contact with the contact point 83, thus completing a short local circuit from the battery 1 through the lead 2 and the conductors 45 and 84 to the lamp 85, thence through the conductor 86 and the contact point 83 and armature 82 and conductor 87, through conductor 38 and contact point 37 to armature 36, thence through the conductors 25 and 11 to said battery. This it will be seen causes the supervisory lamp 85 to light or glow, thereby indicating to the central operator that the subscriber at sub-station A is through talking and ready to be disconnected. In a similar manner the hanging up of receiver 75 at sub-station B will deenergize the relay M and complete another short local circuit through the lamp 43, which latter then lights up and in this way indicates that subscriber B is also ready to be disconnected. Both subscribers having signaled for disconnection the central operator then removes the plug from the jacks, leaving the system in its normal or disconnected condition.

Although only two-way plugs and a two-way cord circuit are employed, the circuit arrangement is such that the system has substantially all of the advantages which characterize the usual three-way system. The differential relays located in the lines afford a simple and effective means for both operating and restoring the line signals. Again, the arrangement of the three supervisory relays in connection with two-way plugs tends to simplify and improve the arrangement and operation of the supervisory signals. In fact the system, although involving a comparatively small number of electrical instruments and also a comparatively simple construction and circuit arrangement, has substantially or practically all of the advantages of more complicated systems, and is characterized by approved methods of operation.

With respect to the busy test, it will be

seen that one terminal of the operator's receiver X is permanently connected to the sleeve side of the line circuit, while its other terminal is adapted to be connected with the tip side of the cord circuit. In this way, a busy test may be obtained by touching the plug tip to the sleeve of the multiple jack, in the ordinary and well-known manner. If the plug of some other cord circuit is in one of the multiple jacks of this line, the operator making the test gets current through her receiver from one pole of the battery, through the tip of the plug, through the testing ring of the jack, through the testing ring of the other jack, through the sleeve of the other plug, and thence back through the other third or master relay of the other cord circuit to the other pole of the battery. Obviously, also, the resistances can be so adjusted that a line will test busy even when no plugs are in any of the multiple jacks of the line, providing, of course, that the subscriber has his receiver off the hook. In such case, the test circuit through the testing operator's receiver includes the switch-hook at the subscriber's station. In other words, the busy test can always be obtained when some circuit or connection is established by which the testing ring of the jack of the line being tested is connected temporarily with both poles of the battery,—or, at least, with the pole from which it is normally disconnected.

It will be seen that the two supervisory relays K and M, as well as the master relay L, are all permanently connected with one and the same pole of the common battery 1. Furthermore, it will be seen that the energizing circuits of all said relays include voice current conductors. Each supervisory lamp is controlled jointly by the master relay and one of the supervisory relays. In addition, it will be seen that each supervisory relay is adapted to be placed in parallel with both windings of a line relay. The plug tips 22 and 60 are each sufficient in themselves to close a normally open gap in a shunt extending around the energizing coil or winding of a line relay.

What we claim as our invention is:

1. In a telephone system, the combination of sub-stations and a central station and suitable line connections between the same, an operator's cord circuit and a central source of current supply located at the central station, suitable connections whereby said source of current supply feeds current to the lines for both talking and signaling purposes, suitable line signals located at the central station, jacks at which said lines terminate, and differential relays in said lines connected and arranged for controlling said line signals, each relay having a pair of coils connected in parallel in the line circuit.

2. In a telephone system, the combination

of stations having suitable line connection, a central source of current supply permanently connected with said line, a circuit changing device at one station, a differential relay at the other station connected and arranged to be operated by said circuit changing device, a line signal controlled by said relay, and a switch for closing a normally open parallel connection through one of the coils of said relay, the coils of said relay being connected in parallel in the line circuit to feed talking current thereto.

3. In a telephone system, the combination of two stations, complete metallic line connection between said stations, a common battery permanently connected with the line, a differential relay having one coil located in said line, a signal lamp associated with said relay, a local circuit including said signal lamp and battery and adapted to be closed by said relay, a circuit changing device at one station for closing the line circuit through said relay, and a plug switch for closing a parallel connection through the other coil of said relay, so as to deenergize the latter and thereby extinguish the said lamp, the coils of said relay being connected in parallel in the line circuit to feed talking current thereto.

4. In a telephone system, the combination of two stations, complete metallic line connection between the same, a common battery permanently connected with the line, a differential relay having one coil permanently connected in the line, a lamp signal associated with said relay, a local circuit including said lamp and battery and also the armature of said relay at one station, a circuit changing device at the other station for closing the line circuit and thereby energizing said relay, and a two-way plug and a jack for closing a parallel connection through the other coil of said relay, so as to deenergize the latter and thereby break the said local circuit, the coils of said relay being connected in parallel in the line circuit to feed talking current thereto.

5. The combination of a telephone line, a differential relay having one coil permanently included in the line circuit, a source of current supply permanently connected with said line, a circuit changing device for closing a parallel connection through the other coil of said relay, retardation coils interposed between the line and the source of current supply, a lamp signal associated with said relay, a local circuit including said lamp and source of current supply and also including the armature of said relay, the coils of said relay being connected in parallel in the line circuit to feed talking current thereto.

6. In a telephone system, the combination of substations and a central station and suitable line connection between the same, jacks

forming the terminals of said lines, a two-strand cord circuit at the central station, a central source of current supply permanently connected with said lines, supervisory signals, local circuits for said signals including said source of current supply, three relays associated with the cord circuit and adapted to conjointly control the operation of said supervisory signals, local circuits for one of said relays including said source of current supply, plugs and jacks for controlling the third one of said relays, and circuit changing devices at the sub-stations adapted to control the other two relays, said third relay energized over portions of the talking circuit.

7. In a telephone system, the combination of sub-stations and a central station and complete metallic line connection between the same, a central source of current supply permanently connected with the lines, jacks at the central station connected with the said lines, two-way plugs and a cord circuit adapted to connect said jacks, circuit changing devices at the sub-stations, relays and calling signals at the central station controlled by said circuit changing devices, another relay at the central station adapted to be energized over portions of the talking circuit by the insertion of either plug in either jack, supervisory lamps associated with said cord circuit, and local circuits for said lamps having switch points controlled by said relays.

8. In a telephone system, the combination of substations and a central station and suitable line connections between the same, jacks at the central station connected with the lines, two-way plugs and a two-way cord circuit for connecting said jacks, a central source of current supply permanently connected with the line, a pair of relays connected in series with the sub-stations when the plugs are inserted, circuit changing devices at the sub-stations for breaking the line circuits and thereby deenergizing said relays, supervisory lamp circuits controlled by said relays, and a third relay for controlling said supervisory lamp circuits, and connected and arranged to be energized by the insertion of either plug whether the circuit changing device be open or closed together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

9. In a telephone system, the combination of two stations, line connections between the same, a source of current supply connected with said line, a line signal at one station, a differential relay in the line associated with

said line signal, a circuit changing device at the other station for controlling said relay, a jack, and a plug and a cord circuit associated with said line signal, a supervisory lamp associated with said plug and jack, a local circuit for said supervisory lamp, a relay for controlling said local circuit, said relay being located in a line circuit including said plug and jack and also said circuit changing device, and a second relay also adapted to control the local circuit of said supervisory lamp, said second relay being connected and arranged to be energized when the plug is inserted in said jack, said source of current supply feeding current to the line for both talking and signaling purposes.

10. A telephone system comprising two-way plugs and a cord circuit, two supervisory lamps, a source of current supply, suitable circuit connections, two circuit breaking relays controlling normally closed switch points in the circuits of said lamps, and a circuit closing relay adapted and arranged to control a normally open switch point in the circuits of said lamps.

11. A telephone system comprising two stations, line connection between the same, a signal, a differential relay associated with said signal and provided with parallel coils connected with the line, a source of current supply, a switch or circuit changing device at one station for closing the line and thereby energizing said relay, and a switch or circuit changing device at the other station for closing the circuit through the other coil of said relay, so as to deenergize the latter and restore said signal, said source of current supply feeding current to the line for both talking and signaling purposes.

12. In a telephone system, the combination of subscribers' lines, an operator's connecting medium for connecting said lines, a suitable source of current supply, line signals, suitable circuit connections, differential relays for controlling said line signals, supervisory signals associated with the operator's connecting medium, and three relays connected and arranged for controlling normally closed and normally open switch points in the circuits of said supervisory signals together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

13. In a telephone system, the combination of two-way plugs and a two-way cord circuit, two supervisory lamps, a suitable source of current supply, suitable circuit connections, and two circuit breaking devices and a circuit closing relay, said devices

and relay respectively controlling normally closed and normally open switch points in the circuits of said lamps, all constructed and organized substantially as described.

5 14. In a telephone system, the combination of a subscriber's line, a centralized source of current connected with the line, a differential relay in the line circuit, a line signal controlled by said relay, and a three-way jack and a two-way plug for closing a line circuit through one coil of said relay, so as to deenergize the latter, said source of current supply feeding current to the line for both talking and signaling purposes.

15 15. In a telephone system, the combination of a subscriber's line, a source of current connected with the line, a differential relay connected in the line circuit, a line lamp signal controlled by said relay, and a plug and jack adapted to close a line circuit including one coil of said relay, said source of current supply feeding current to the line for both talking and signaling purposes together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

16. A telephone system comprising a subscriber's line, relay mechanism involving a plurality of energizing coils, a subscriber's hook-switch for closing a line circuit through one of said coils, a source of current in said line circuit, a line lamp signal controlled by said relay mechanism, and a plug and jack and suitable connections for closing a line circuit through another of said coils, said source of current supply feeding current to the line both for talking and signaling purposes.

17. In a telephone system, the combination of a subscriber's line having two metallic limbs, a battery connected with the line, a relay in the line circuit, said relay having parallel differentially wound coils, a line lamp signal controlled by said relay, a subscriber's switch for controlling the operation of said relay, and a three-way jack and a two-way plug for closing a circuit through one coil of said relay, so as to deenergize the latter together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

18. In a telephone system, the combination of differentially wound line relays, and three supervisory relays, together with local signal circuits having normally open and

normally closed switch-points controlled by said supervisory relays together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

19. In a telephone system, the combination of a common battery for talking and signaling purposes, differentially wound line relays, supervisory relays, and local signal circuits having normally open and normally closed switch-points controlled by said supervisory relays together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

20. In a telephone system, the combination of a common battery for supplying both signaling and talking current, and differentially wound line relays together with means whereby the insertion of any plug in a jack accomplishes the establishment of two parallel connections extending around the energizing coil of the line signal means, the plug-tip at such time being included in both of said temporarily established parallel connections extending around the said energizing coil.

21. 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, and a supervisory signaling device having the continuity of its circuit controlled at one point by said relay together with a differentially wound line signaling device adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

22. The combination with a telephone line, of a battery permanently connected with the 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, and a supervisory signal having its circuit controlled at one point by said relay together with a differentially wound line signaling device adapted to have its windings connected in parallel

with each other and in parallel with a supervisory relay winding when a connection is made to the line.

23. The combination with a telephone line, of a battery permanently connected with the 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, and a supervisory signal placed in operative condition by the actuation of said relay together with a differentially wound line signaling device adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

24. The combination with a telephone line, of a battery permanently connected with the 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 sub-station of the line and the other relay being in a branch circuit closed when connection is made with the line, and a supervisory signal jointly controlled by said relays together with a differentially wound line signaling device adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

25. The combination with a telephone line, of a battery permanently connected with the 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 the 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, and a supervisory signal having its circuit controlled by said relays together with a differentially wound line signaling device adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

26. The combination with a telephone line, of a battery having 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, and a supervisory signaling device having the continuity of its circuit controlled at one point by said relay, together with a differentially wound line signaling device permanently connected in the line circuit and adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

27. The combination with a telephone line, of a battery permanently connected with the 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, and a supervisory signal having its circuit controlled at one point by said relay, together with a differentially wound line signaling device permanently connected in the line circuit and adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

28. The combination with a telephone line, of a battery permanently connected with the 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, and a supervisory signal placed in operative condition by the actuation of said relay, together with a differentially wound line signaling device permanently connected in the line circuit and adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

29. The combination with a telephone line, of a battery permanently connected with the 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, and a supervisory signal jointly controlled by said relays, together with a differentially wound line signaling device permanently connected in the line circuit and adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

30. The combination with a telephone line, of a battery permanently connected

closed and normally open switch points in with the line at the central office, a cord circuit, supervisory relays connected between the cord circuit and the battery,

5 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 the 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, and a supervisory signal having its circuit controlled by said relays, together with a differentially wound line signaling device permanently connected in the line circuit and adapted to have its windings connected in parallel with each other and in parallel with a supervisory relay winding when a connection is made to the line.

31. A common battery telephone system comprising a line relay, a plug contact adapted and sufficient in itself to close a normally open gap in a shunt extending around a winding of said line relay, said shunt including another winding of said relay, and a battery for supplying talking current through said relay to the talking circuit.

32. A common battery telephone system comprising a line relay, a plug contact adapted and sufficient in itself to close a normally open gap in a shunt extending around a winding of said line relay, said shunt including a suitable relay winding, and a battery for supplying talking current through said relay to the talking circuit.

33. In a telephone exchange system, a telephone line, a differential line relay having one winding thereof permanently connected in the line circuit, a parallel connection including the other winding of said relay, a pair of normally separated jack contacts in said parallel connection, a plug contact adapted to electrically connect said jack contacts together to deenergize said relay, and a battery for supplying talking current through said relay to the talking circuit.

34. In a telephone exchange system, a telephone line, a differential line relay, means for connecting the relay windings in parallel in the line circuit to prevent the relay from energizing, a supervisory relay coil, and means for connecting said coil in parallel with both of said differential relay windings.

35. In a telephone exchange system, a telephone line, a differential line relay, means for connecting the relay windings in parallel in the line circuit to prevent the relay from energizing, a supervisory relay coil, and means for connecting said coil in parallel with both of said differential relay wind-

ings, together with an energizing circuit for said supervisory relay coil, and a voice current conductor included in said energizing circuit.

36. In a telephone exchange system, a telephone line, a differential line relay, means for connecting the relay windings in parallel in the line circuit to prevent the relay from energizing, a supervisory relay coil, and means for connecting said coil in parallel with both of said differential relay windings, together with an energizing circuit for said supervisory relay coil, and a voice current conductor included in said energizing circuit, a second supervisory relay, a local energizing circuit for said second supervisory relay, and a supervisory signal controlled jointly by said supervisory relays.

37. In a telephone exchange system, a common battery, telephone lines, a pair of supervisory relays, a third or master relay, a pair of supervisory signals, each signal controlled jointly by the master relay and one of said supervisory relays, line circuits for energizing the supervisory relays, and local circuits for energizing the master relay, all said relays permanently connected with one and the same pole of said battery.

38. The combination with a telephone line, of a source of electricity and a pair of relays adapted to be bridged between the limbs of the talking circuit thereof, a hook switch at the substation and a plug switch at the central station for controlling the circuit through said relays, a signal adapted to be controlled by the conjoint action of said relays, a line signal device, a cord circuit, and means entirely independent of the said relays and cord circuit, but operated by the said plug-switch, for retiring the line signal when the operator answers the call.

39. In a telephone system, the combination with a telephone line, of a source of current and a relay bridged between the two limbs of the talking circuit thereof, a second relay at the central office connected in a circuit including a portion of one side of the talking circuit and means for energizing it, a hook switch at the substation and a plug switch at the central station for controlling the circuit through said relays, a signal controlled by the conjoint action of said relays, a line signal device, a cord circuit, and means entirely independent of the said relays and cord circuit, but operated by the said plug-switch, for retiring the line signal when the operator answers the call.

40. In a telephone system, the combination with a telephone line, of a source of electricity at the central office, a plug-switch, a pair of relays, one of said relays being energized from the said source of electricity as long as the said plug-switch is closed and over a path having a part coincident with

the talking circuit, and the other relay being energized as long as the said plug-switch is closed and when the subscriber's telephone is in use, a signal associated with
5 said pair of relays, the circuit of said signal being established by the operation of the first of said relays, and said signal being rendered inoperative by the operation of the second of said relays, a line signal device, a
10 cord circuit, and means entirely independent of the said relays and cord circuit, but operated by the said plug switch, for retiring the line signal when the operator answers the call.

Signed by me at Chicago, Cook county, 15 Illinois, this 28th day of January, 1902.

DAVID L. TEMPLE.

Witnesses:

ARTHUR F. DURAND,

HARRY P. BAUMGARTNER.

Signed by me at Atlantic City, Atlantic county, New Jersey, this eighth day of February 1902.

CHARLES L. GOODRUM.

Witnesses:

JOHN C. REED,

JNO. W. GOODRUM.

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