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H. P. CLAUSEN.

TELEPHONE SYSTEM.

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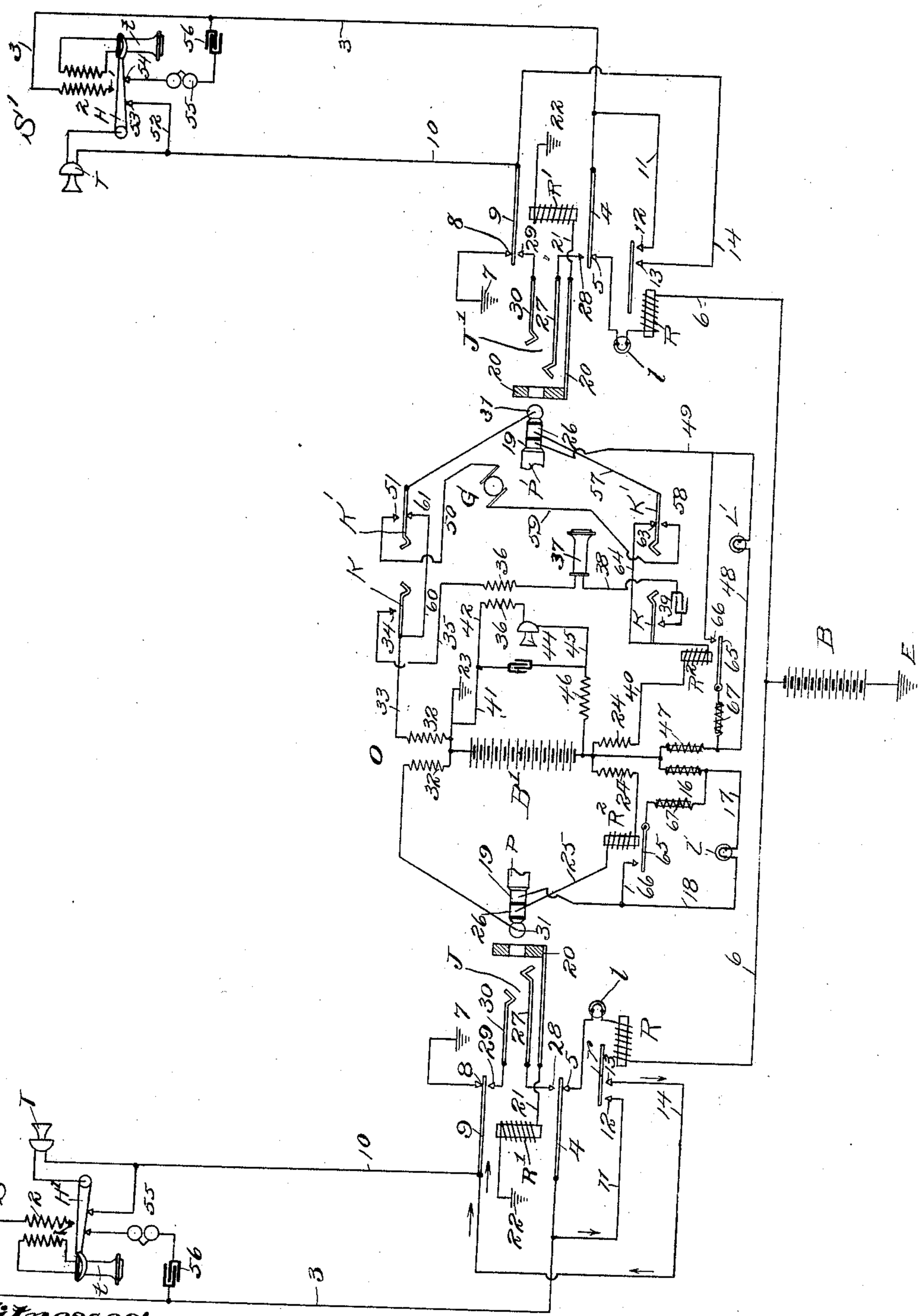

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TELEPHONE SYSTEM.

No. 866,714. Specification of Letters Patent. Patented Sept. 24, 1907.

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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 a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in general; but more particularly to systems of the central energy type, and especially to systems in which complete metallic circuits are provided for talking and ringing the bells at the substations.

Generally stated, the object of my invention is to provide certain details and features of improvement which will tend to increase the general efficiency of a telephone system of this character.

Certain special objects are to provide a circuit arrangement which will permit the central operator to answer a call without producing objectionable or disagreeable sounds in the receiver at the substation, and which will permit the signaling current to hold the calling signal in operation until the call is answered, it being also an object of the invention to provide a circuit arrangement of such character as to enable the signaling battery to operate or light a calling signal lamp through a short local circuit of comparatively low and unvarying resistance.

Other special objects of my invention are to provide an improved construction and arrangement by which the relay which connects the normally disconnected jack with the subscriber's line is energized over a circuit including the common battery or centralized source of current supply, and including also a strand of the cord circuit—that is to say, a strand of the operator's flexible conducting cord by which any two subscribers' lines are connected together for conversational purposes; to provide an improved construction and arrangement by which the normally disconnected jacks and other features characteristic of a system of this kind are combined with a supervision which is absolutely independent of the ground at the subscribers' stations, whereby the subscribers in signaling for a disconnection do not use the ground between the substations and the exchange or central station; to provide an improved construction and arrangement whereby it will not be necessary to use a series of normally open contacts in the normally disconnected jacks for closing the energizing circuits through the relays which have the double function of disconnecting the individual line signals and establishing connection with the subscribers' lines whenever an operator's cord-plug is inserted to make connection with the line; to provide an improved construction and arrangement whereby the coil or winding of the individual line relay may have two energizing circuits, one a line circuit for initially energizing the relay and the other a local circuit adapted to displace or supplant the line circuit for the purpose of clearing the line of current and locking or holding the line signal in operation until the operator answers the call; and to provide a construction and circuit arrangement whereby a centralized source of talking and signaling current is adapted to supply talking current to the subscribers' transmitters and at the same time energize the relays which connect the normally disconnected jacks with the line over circuits including the flexible connecting cord by which the operator temporarily establishes connection between any two subscribers' lines.

It is also an object, as will hereinafter more fully appear, to provide certain novel combinations and circuit arrangements which will tend to increase the general efficiency and serviceability of a telephone exchange system.

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

The accompanying drawing is a diagram of a telephone system embodying the principles of my invention.

In said drawing, S designates the telephone set constituting any one subscriber's station, S^1 the telephone set constituting any other subscriber's station, and O the intermediate apparatus of the central station exchange, including the operator's telephone set and the cord or plug circuit. It will be readily understood that the subscriber's substation apparatus can be of any suitable known or approved character. At the exchange or central station, the jacks J and J′ are normally disconnected from the subscribers' lines to which they are allotted, and the cut-off relays R′ each have one terminal connected with the grounded pole of the common battery B′ and the other terminal connected with the sleeve or thimble of the associated jack. It will be understood that the batteries B and B′ can be one and the same battery—that is to say, one battery can be employed if desired. The operator's cord-connecting apparatus comprises the answering plug P and the calling plug P′ which are, as usual, adapted for insertion in the said jacks to connect together the lines of the calling and called subscribers. The line relay R at the left is individual to the subscriber's line leading from the substation S, while the similar line relay R at the right is individual to the line leading from the substation S′. The supervisory relay R^2 at the left is associated with the answering plug of the operator's cord circuit, and the similar supervisory relay R^2 at the right is associated with the

calling plug of the said cord circuit. As shown, each line normally has both limbs or sides thereof connected with the opposite poles of the common battery or centralized source of current. The telephone instruments, the relays, lamps, operators' key switches, the various condensers, and other similar devices, can, of course, be of any suitable known or approved form of construction consistent with the mode of operation of the system and the various results and advantages to be obtained thereby. The arrangement of such apparatus in a system embodying the present improvements will perhaps be most readily understood by tracing the circuits existing in the system from time to time as the several different possible connections of the system are made, as follows: If subscriber S wishes a connection he calls the operator at the central station by lifting his receiver from the hook H. This immediately completes a circuit from the hook, through the contact 1, and the primary 2 of the induction coil of the receiver circuit, and through the line 3, to one of the armatures 4 of the duplex relay R′, thence through contact 5, lamp L, and coil of another relay R and through connection 6 to battery; thence from the battery through the ground connection E to another ground connection 7 and contact 8 to the other armature 9 of the relay R′, and thence through line 10 and transmitter T back to the hook H. The flow of current through the circuit thus established will cause the relay R to attract its armature *r* against adjacent contact points 12 and 13 and close a local cross circuit from the line 3 through connection 11, contact 12, armature *r*, contact 13, and connection 14 to the line 10, and the flow of current resulting in this local circuit will light a signal lamp *l* connected therein and thus attract the operator's attention to the fact that a connection is wanted, the flow of current to feed the lamp then being from battery B, through 6 and R to the lamp and from the lamp through 5, 4, 11, 12, *r*, 13, 9, 8, 7, and E, back to the battery B.

The operator responds by placing the plug P in the subscriber's jack J whereupon a circuit will be established from the battery B′ through an impedance coil 16 and line 17 to a supervisory lamp *l′*, and from this lamp through connection 18, a sleeve 19 of the plug to the sleeve 20 of the jack, thence through connection 21 and through the coil of relay R′ into the ground at 22, and thence through the earth back to the battery by way of ground connection 23. The flow of current through this circuit will cause the relay R′ to attract both of its armatures 4 and 9, and to establish a talking circuit from the battery through a repeating coil 24 and through the coil of a relay R^2 and connection 25, to the intermediate ring 26 of the plug, and from this intermediate ring through the intermediate spring 27 of the jack and contact 28 to the armature 4 of the relay R′ and thence through the line 3, coil 2 and contact 1, to the switch H′ and transmitter T; thence back through line 10, armature 9, contact 29, tip spring 30 of the jack, tip 31 of the plug and repeating coil 32, thence to the battery. The shifting of the armature 4 of the relay R′ will also open the circuit through the relay R and permit its armature *r* to fly back and disconnect the contacts 12 and 13, thus opening the circuit through the signal lamp *l*, and restoring or extinguishing the latter. The operator then presses the listening key K and completes a circuit from the battery B′ through the other side of the repeating coil 32, connection 33, key K, contact 34, connection 35 and induction coil 36 to the receiver 37 of the operator's set, and thence through connection 38, contact 39, key K, relay R^2 connection 40, and the other side of the repeating coil 24 to the battery. The operator's transmitter is connected in a circuit leading from the battery through connections 41 and 42 and through the induction coil 36 to the transmitter 44, and thence through connection 45 and impedance coil 46, back to the battery. The operator can consequently now talk inductively with subscriber S and find out the number of the station with which connection is wanted. This may be assumed to be station S^1 with which the operator proceeds to make connection by placing the plug P^1 in the jack J^1 corresponding to that station. The insertion of this plug completes a circuit from the battery B′, through impedance coil 47 and connection 48, to a supervisory lamp l^1 and from the lamp through a connection 49 to the sleeve 19 of the plug P^1, thence through the sleeve 20 of the jack by connection 21 to the coil of the duplex relay R^1, and thence to ground and into the ground at 22, and thence through the earth and through ground connection 23, back to the battery. The supervisory lamp l^1 will thereupon light up and will remain lighted until the subscriber at station S^1 removes his receiver *t* from the hook. The energizing of the relay R^1 will also attract armatures 4 and 9, against contacts 28 and 29, respectively, and thus enable the operator to call up station S^1 by pressing the ringing key K′ to bring the ringing generator G into circuit with the bell of station S^1. The circuit connections will then be from the generator G through connection 50 and contact 51, key K^1, tip 31, tip spring 30, contact 29, armature 9, line 10, connection 52, contact 53, hook H, and contact 54 to the bell 55 and from the bell through condenser 56, line 3, armature 4, contact 28, jack spring 27, plug ring 26, connection 57, key K^1, contact 58 and connection 59 back to the generator. The supervisory lamp l^1 will continue to burn during this time until the ringing key has been released and the receiver *t* at station S is lifted from the hook, whereupon a circuit will be established from the battery B′ through the repeating coil 32 and connections 33 and 60, contact 61, key K′, plug tip 31, tip spring 30, contact 29, armature 9, and line 10, to the transmitter T and hook H and thence through contact 1, induction coil 2, line 3, armature 4, contact 28, jack spring 27, plug ring 26, connection 57, key K^1, contact 63, connection 64, relay R^2, connection 40, and repeating coil 24, back to the battery. This puts stations S and S^1 into talking communication inductively through the repeating coils 24 and 32, and at the same time moves the armature 65 of the relay R^2 and short circuits and extinguishes the supervisory lamp l^1 through a contact 66 and impedance coil 67. The replacing of the receiver *t* upon the hook of station S^1 will, however, open the circuit through relay R^2 again and permit its armature to drop, thus restoring the supervisory signal which will then remain displayed until the line to station S^1 is finally opened by the withdrawal of its plug from its jack. In the meantime, the supervisory lamp l^1 for station S will not have lighted, owing to the fact that the same act of inserting the plug P which completed the circuit through the lamp by way of connections 17 and 18, will also have brought about

the energizing of the relay R^2 on this side and the consequent moving of its armature 65 to short circuit the lamp through contact 66 and impedance coil 67. But as with lamp l^1, the replacing of the receiver t upon its hook will open the circuit through the relay R^2 and permit the armature 65 to drop back and open the shunt, thus directing the current through the lamp l^1 causing the latter to light up and remain lighted until the line to station S is opened by the withdrawal of the plug P.

Thus it will be seen that the connections 11 and 14, and the armature r constitute a short circuiting connection or arrangement by means of which the battery B and the relay R may be made part of either a local or the substation circuit. When a call is sent in from the substation the local or short circuit immediately closes and takes up the signaling current and excludes it from the line. This leaves the receiver of the substation practically out of circuit with the battery, and consequently the insertion of the plug and the operation of the cutout relay R′ does not cause an unpleasant sound in the receiver. As stated, the conductors 11 and 14 and the armature r constitute a short-circuiting connection, which is normally open, but which closes as soon as a call is sent in. This short-circuiting connection is preferably of low resistance and when closed operates to effectually exclude the calling signal current from the line. In other words, this short-circuiting connection operates to automatically short-circuit the substation from whence the call came. This short-circuited condition of the substation continues until after the local circuit has been broken or opened up for the purpose of extinguishing or restoring the calling signal. In this way, the breaking of the line circuit in answering a call does not produce any sound in the receiver at the substation, inasmuch as no current is on the line at the time this breaking of the line circuit occurs. Furthermore, the arrangement has the advantage of enabling the battery B to light lamp l through a short local circuit of comparatively low and unvarying resistance. This lamp, which is the calling signal, remains lighted until the plug P is inserted in the jack J, regardless of whether the receiver at the substation is hung up or not.

Preferably, and in order to insure the best results, the jacks are normally insulated from the lines. In other words, each jack is normally disconnected from the line to which it is allotted. The cut-out relays, however, serve to establish connection between the lines and the jacks, upon the insertion of the cord plugs. These cut-out relays, as stated, also serve to sever the connections between the battery and the lines. Preferably, one terminal of each cut-out relay is permanently connected with a source of current, and the other terminal of such relay is preferably permanently connected with the sleeve contact or thimble of the adjacent jack. The coil of each line relay is adapted and arranged to form part of either the line or the local line lamp circuit. It will be readily understood that the resistance of the various relays and resistance coils can be adjusted or regulated by those skilled in the art to give the desired results, and in accordance with the conditions of any particular case. Preferably, the battery for supplying the signaling current has both poles normally connected with both sides of the line. The jacks and the cord-circuit, as illustrated, are preferably three-way in character, the jacks and plugs having the usual tip, ring, and sleeve contacts.

An important feature of my invention is the energizing of the cut-off relays R′ over circuits including the cord strands. As shown, the third strand of the cord is used for this purpose. It will be understood, however, that for this feature of my invention I do not limit myself to any particular number of parallel strands. Furthermore, and as a feature of special improvement, the cord strand energizing circuit for the cut-off relay is combined with a supervision which is independent of the ground between the subscribers' stations and the central station. With this combination, as set forth, the signaling is all carried on over the line, and without using the ground at the substation.

The cut-off relays R′ not only serve when energized to connect the lines with the normally disconnected jacks or line terminals, but also to disconnect the individual line signals from the lines.

The bells or ringers 55 are bridged across the lines, and the condensers 56 stop the flow of battery current through said bells or ringers, but leave the latter responsive to ringing currents supplied from the bridged generator G, whereby the ground is not used for ringing.

It will also be seen that I combine a common battery normally disconnected jack system with a supervision which is absolutely independent of the ground at the substations.

The short circuit closed by any energized line relay R has the double function of quieting the line and locking or holding the line signal in operation until the operator answers. Each line relay has two energizing circuits, one a line circuit, and the other a local circuit, the latter displacing or supplanting the former when the subscriber calls. Both of these circuits are, it will be seen, controlled by relay contacts. The line circuit for initially energizing the line relay includes both sides of the line in series, substantially as shown.

While I have elected to illustrate all of the features and combinations of my invention in connection with a full common battery telephone system, it will be seen that the said features and combinations are more or less applicable to other systems, and for this reason I do not limit myself altogether to a common battery system.

Obviously, the foregoing and other features and advantages will be readily understood and appreciated by those skilled in the art of telephony.

If my invention or improvements are used in an exchange, where such is necessary, it is evident that any well known or suitable form of busy test can be employed.

With my improved circuit arrangement and combinations, the two normally disconnected jack contacts 27 and 30 are both included in the talking circuit, the supervisory relay energizing circuit, the ringing circuit, and the battery circuit for the transmitter T. In this way these two contacts which are normally disconnected from the line have a plurality of important functions or functional relations to other elements.

With further reference to the quieting of the line, when the operator plugs in, it will be seen that the battery current is removed from the winding of the line relay before the short-circuit is removed from across

the line—that is to say, the circuit of the line relay R is broken or opened, when the operator plugs in, before the armature thereof is released, and consequently before the short-circuit composed of the conductors 11 and 14 is opened or removed from across the line, thus, as previously explained, preventing clicks or noises in the receiver which the calling subscriber is holding to his ear at the time that the operator answers the call.

What I claim as my invention is,

1. In a telephone system, the combination of stations and line connection between the same, a calling device at one of said stations, a calling signal and a battery at the other station, a normally open local circuit including said battery, said battery being normally connected with the line, and a relay for closing said local circuit, the operation of said calling device causing the current of said battery to first flow over the line, the energization of the relay then operating to transfer the current to said local circuit, and a talking circuit including both sides of the calling circuit.

2. In a telephone system, the combination of a substation and a central station, a line circuit connecting said substation and said central station, a calling device at said substation, a calling signal and a relay and a battery at the central station, a normally open local circuit including said battery and relay, said battery being normally connected with the line, said local circuit when closed by the relay operating to completely short-circuit the said substation, so as to permit the operator to answer a call without producing sounds in the receiver at said station, and a talking circuit including both sides of the calling circuit.

3. In a telephone system, the combination of a substation and a central station and suitable line connection between the same, a calling device at said substation, a calling signal at the central station, a relay and a battery at said central station, a normally open local circuit including said battery and relay, said relay and said calling signal being responsive to said calling device, and the local circuit when closed by the relay operating to hold or lock the calling signal in operation until the call is answered by the operator, and a talking circuit including both sides of the calling circuit.

4. In a telephone system, the combination of a sub station and a central station, suitable line connection between said stations, a hook-switch at the sub station for opening and closing the line circuit, a spring-jack at the central station normally insulated from the line, a normally open short-circuit connection across the two limbs of the line at the central station, a battery normally connected with one limb of the line, a line relay for operating a line signal and arranged to close said normally open short-circuit connection, a normally open local circuit including said relay and battery, and also including said short-circuit connection, a cord-circuit having a plug adapted for insertion in said jack, said cord-circuit being connected with a suitable source of current supply, and a cut-out relay adapted to be energized when the plug is inserted in the jack, said cut out relay when energized establishing connection between the jack and the line, and also operating to break the said local circuit and deënergize said line relay.

5. In a telephone system, a substation and a central station and line connection between the same, a calling signal and a battery for operating the same at the central station, said battery and signal being normally connected with the line, the signal serving as a medium of connection between the battery and line, a calling device at the substation for operating said calling signal, the line being normally open at the substation and a normally open local circuit which closes when a call is sent in and which holds the calling signal in operation until restored by the operator, and a talking circuit including both sides of the calling circuit.

6. In a telephone system, a substation and a central station and normally open line connection between the same, a calling signal consisting of a lamp arranged to light when a call is sent in from the substation, a relay associated with said lamp a suitable device at the substation for causing the operation of said calling signal, a battery at the central station for supplying current to said lamp said battery being normally connected with the line through said relay and lamp, and a local circuit which is closed when a call is sent in and which affords a short circuit of comparatively low and unvarying resistance through which the current from said battery flows for the purpose of lighting said lamp.

7. A telephone system comprising a substation, with the normally open line thereof a battery and relay at the central station, said line normally connected with the battery and relay at the central station, a local circuit normally open but closed by said relay when a call is sent in from said substation, said local circuit when closed operating to exclude the current of said battery from the substation, a calling signal displayed when said local circuit is closed, and a circuit breaking device for opening said local circuit, a metallic talking circuit, and means for using both sides of said talking circuit in calling.

8. A telephone system comprising a substation and a central station with line connection, a battery and a local circuit at the central station, a relay for closing the current of said battery through said local circuit when a call is sent in the battery being normally connected with the line through said relay, and the relay forming a part of both line and local circuits, a calling device at the substation for operating said relay, and a calling signal at the central station associated with said relay and operated by said battery, and a talking circuit including both sides of the calling circuit.

9. In a telephone system, a substation and a central station with complete metallic line connection between the same, a relay and calling signal and a battery for operating the same at the central station, a short-circuiting connection between the line terminals at the central station, said short-circuit connection being normally open, a calling device at the substation adapted to operate said relay and thereby close said short-circuit connection, the said calling signal being also responsive to said calling device a local circuit including the battery and relay and short-circuit connection, the said short-circuiting connection operating to exclude the current of said battery from the substation line as soon as the relay is operated by a call, and a circuit-breaking device for opening said local circuit and thereby restoring said signal.

10. In a telephone system, a substation and a central station and a complete metallic line connection between the same, a calling device at the substation, a lamp and a relay and a battery for operating the same at the central station, and a short-circuit connection between the substation line terminals at the central station, said short-circuiting connection being normally open but closed by said relay when a call is sent in, said relay and short-circuiting connection forming part of a local circuit of comparatively low and unvarying resistance through which the current from said battery flows for the purpose of lighting said lamp, and a circuit-breaking device for opening up said local circuit and restoring or extinguishing said lamp.

11. In a telephone system, a substation and a central station and complete metallic line connection between the same, a lamp signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the line terminals at the central station, said short-circuit connection being normally open, and a calling device at the substation for operating said relay and thereby closing the said short-circuit, a cut-out relay for opening up said short-circuit connection and extinguishing said lamp, a spring jack and a plug and cord circuit with a battery for operating said cut-out relay.

12. In a telephone system, a substation and a central station and a complete metallic line connection between the same, a spring jack and a plug and a cord circuit with a clearing out signal, a complete metallic line circuit which is opened to operate said clearing-out signal, a calling signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the terminals of the line at the central station, said short-circuit connection being normally open a local circuit including the battery and relay and short-circuit connection, and a calling device at the substation for operating said relay and thereby closing said short-circuit connection

so as to exclude the signal current from the main line after a call is sent in.

13. In a telephone system, the combination of a substation and a central station, a complete metallic line connection between the same, connection between the line terminals at the central station, said connection being normally open, a signal lamp and a relay and a battery for operating the same located at the central station, a normally open local circuit including said battery and relay and also said normally open connection, a receiver-hook or switch at the substation for operating said relay and thereby closing the said normally open connection between the line terminals, so as to cause current from said battery to flow through said lamp, a spring jack and a plug and a cord-circuit with a clearing out signal, and suitable connections for supplying battery current to the line through the talking strands of said cord-circuit, the complete metallic line circuit being opened to effect the operation of said clearing-out signal.

14. In a telephone system, the combination of a substation and a central station with a complete metallic line connection between the same, a short-circuit connection between the line terminals at the central station, a relay having its armature adapted and arranged to close said short-circuit connection when a call is sent in from said sub-station, a battery which operates the relay when the calling device at the substation is operated, the short-circuit connection when closed forming part of the local circuit for the current of said battery, a calling signal lamp located in said local circuit at a point outside of said short-circuit connection, the latter when closed thereby operating to exclude the current of the signal battery from the main line, a cut-out relay for opening-up said short-circuit and thereby extinguishing said lamp, a spring jack having suitable connection with said cut-out relay, a plug and cord circuit with a battery, a clearing-out signal in said cord circuit, and a complete metallic line circuit which is opened to operate said clearing-out signal.

15. In a telephone system, the combination of a subscriber's line, a hook switch for opening and closing the line circuit, a battery normally connected with the line, a line relay for operating the line signal, a normally open short-circuit connection across the line terminals at the central station, said short-circuit connection being closed by the energization of the line relay when a call is sent in, and a local circuit including said battery relay and short-circuit connection, the said relay being located in a conductor forming part of both the line and local circuits.

16. In a telephone system, a line circuit normally open at one station; a switch or like circuit-changer therefor at said station; a source of current, a relay, and a signal receiving device all at another station, and a normally open associated local circuit at said other station leading through the contact points of said relay and controlled thereby; the said source, relay, and signal device being in a section of conductor forming part of both line and local circuits.

17. The combination in a central battery telephone exchange, of a main circuit normally open at a substation and extending therefrom to a central station; and a circuit-changing switch therefor at said substation; with a normally open associated local circuit, a source of current, a relay responsive to the operation of said circuit-changer and a signal receiving device, all at said central station; the said source, the magnet of said relay, and the signal device being serially connected in the main circuit, and together with contact points of said relay in the associated local circuit also; and the said relay constituting a switch to close said local circuit, and to divert the current of the source from said main circuit through the said local circuit for the operation of said signal device.

18. In a telephone system, the combination of a metallic main circuit normally open at a substation and extending therefrom to a central station; a circuit-changing switch therefor at said substation; and an earth connection normally attached to one main conductor of said metallic circuit at said central station; with a source of current, a cutoff relay controlling the conection of said source with the main circuit conductors; an independent relay responsive to the action of said circuit-changer; and a normally detached auxiliary earth connection for the other main conductor of said metallic circuit leading through and controlled by the contact points of said independent relay; the said source and the magnet of said independent relay being serially connected in the main circuit; and the said auxiliary earth connection being branched from its associated main conductor at a point external to the cutoff relay connection of said source; whereby a short circuit for said source is constituted between the said two earth connections immediately pursuant to the operation of said substation circuit-changer to transmit a call signal, and the consequent operation of said independent relay.

19. In a central battery telephone exchange system, the combination with a main or subscriber's circuit normally open at a substation and extending therefrom to a central station; a telephone receiver and a telephone suspension switch both at said substation, the latter being adapted on the removal of said receiver therefrom to close said circuit and thereby transmit a call signal to said central station; a battery supplying current to said main circuit; switchboard devices for answering call signals transmitted over said main circuit by the operation of said substation switch; and a cutoff relay responsive to the normal operation of said switchboard devices, and acting to sever the normal connection of said battery with said main circuit, all at said central station; of associate switching and signaling devices, also at said central station, comprising an independent relay responsive to the signaling operation of said suspension switch, and a signal-receiving device controlled thereby, both normally connected in series in said main circuit together with said battery; and means actuated by said independent relay for short-circuiting the current of said battery through said relay and signal device when a call signal is transmitted from said substation, and before said cutoff relay is operated by said switchboard call answering devices to sever the connection of said battery with said main circuit.

20. In a central battery telephone exchange system, the combination with a main or subscriber's circuit normally open at a substation and extending therefrom to a central station; a telephone receiver and a telephone suspension switch, both at said substation, the latter being adapted on the removal of said receiver therefrom to close said circuit and thereby transmit a call signal to said central station; a battery supplying current to said main circuit; switchboard devices for answering call signals transmitted over said main circuit by the operation of said substation switch; and a cutoff relay responsive to the normal operation of said switchboard devices, and acting to sever the normal connection of said battery with said main circuit all at said central station; of associate switching and signaling devices, also at said central station, comprising an independent relay, and a signal receiving device controlled thereby both normally connected together with said battery in series in said main circuit; and a normally open local circuit leading through the contact points of said relay, and also containing said battery, relay, and signal device; the said relay being responsive to call signals transmitted by said suspension switch, and adapted when operated to close the said local circuit, and thereby divert the battery current from the main circuit thereto; whereby the said signal device may be operated by current flowing in said local circuit, and maintained in operation by said relay, and whereby abrupt changes in the electrical condition of the main circuit when the battery is disconnected therefrom by the cutoff relay, and sounds produced by such changes in the substation receiver may be prevented.

21. In a telephone system the combination of subscribers' lines, subscribers' hook switches for opening and closing the line circuits, jack springs normally insulated from the line, a battery normally connected with the lines, line relays for operating line signals and adapted to be energized when the line circuits are closed by the said hook switches, normally open connections across the line terminals at the central station, said normally open connections being closed when the said line relays are energized, an operator's cord-circuit provided with plugs adapted for in-

sertion in said jacks, said cord-circuit being connected with a suitable source of current supply, local circuits including said battery and line relays and also including said normally open connections, cut out relays connected and arranged to be energized by the insertion of the said plugs in said jacks, said cut out relays when energized establishing connection between the jacks and the lines, and also operating to break the said local circuits and de-energize said line relays.

22. A telephone system comprising a subscriber's line consisting of two metallic limbs, suitable substation apparatus, suitable central station apparatus, a normally open low resistance connection across the terminals of the two limbs at the central station, and a relay for closing said connection, said connection when closed operating to short-circuit the said sub-station apparatus.

23. In a telephone system, the combination of a subscriber's line, means for closing the line, a three-way spring jack normally insulated from the line, a three-way cord circuit provided with a plug adapted for insertion in said jack, a central source of current supply connected with the line and the cord-circuit, a line relay for operating a calling-signal, a cut-out relay for establishing connection between the jack and the line, said cut-out relay being energized by the insertion of the plug in the jack, a local circuit including said source of current supply, and also including said line relay, said local circuit being broken when the cut out relay is energized, and the local circuit for said cut out relay including said source of current supply and also including the sleeve contacts of the jack and plug and the third strand of the cord-circuit.

24. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line, a spring-jack normally insulated from the line, an operator's cord circuit having a plug adapted for insertion in said jack, a line signal, adapted to be operated when the line circuit is closed, a source of current connected with the cord circuit, a cut-out relay for establishing connection between the line and the jack, said cut-out relay being energized when the plug is inserted in the jack, one terminal of said cut-out relay being permanently connected with said source of current supply, the local circuit of said cut-out relay including the sleeve contacts of the jack and the plug.

25. In a telephone system, the combination of a subscriber's line, a subscriber's hook switch for opening and closing the line circuit, a three-way spring jack normally insulated from the line, an operator's three-way cord-circuit provided with a plug adapted for insertion in said jack, a battery bridged across the strands of the cord-circuit, a line signal adapted to be operated when a call is sent in and the line-circuit closed, a cut-out relay for restoring said line signal and adapted to establish connections between the jack and the line, said cut-out relay having one terminal connected with a sleeve or testing ring of said jack, and the other terminal of said cut-out relay being permanently connected with said source of current supply.

26. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line circuit, a normally open connection across the line terminals at the central station, a source of current supply normally connected with the line, a line relay adapted to be energized when a call is sent in, and arranged to close said normally open connection, a spring jack and an operator's cord-circuit provided with a plug adapted for insertion in said jack, a supervisory lamp associated with said cord-circuit, a normally open shunt around said lamp adapted to be closed while the plug is inserted in the jack and the line-circuit is closed and a cut-out relay for restoring the line signal and adapted to be energized when the plug is inserted in said jack.

27. In a telephone system, the combination of a subscriber's line, a subscriber's hook switch for opening and closing the line, a spring-jack normally insulated both from the line and the ground, a source of current connected with the operator's cord circuit, a normally open short-circuit connection across the line terminals at the central station, a line relay adapted to respond to calls sent in from the sub-station and arranged to close said normally open short-circuit connection, a line signal operated by said line relay, a cut-out relay for restoring said line signal and adapted to establish connection between the jack and the line, the said cut-out relay being energized by the insertion of the plug in the jack, a supervisory lamp associated with the cord-circuit, and a normally open shunt around said lamp, said shunt being closed while the plug is in the jack and the line circuit closed, but said shunt opening and causing said lamp to glow when the line circuit is broken.

28. In a telephone system, the combination of sub-stations and a central station, complete metallic line connections between said stations, subscriber's hook switches at the sub-stations for opening and closing the lines, spring-jacks at the central station normally insulated from the lines, normally open short-circuit connections across the line terminals at the central station, a source of current normally connected with the lines, line relays adapted to be energized by the closing of the line circuits and to close said normally open short circuit connections, line lamp signals in series with said line relays, an operator's cord circuit provided with plugs adapted for insertion in said jacks, a source of current bridged across the said cord-circuit, supervisory lamps associated with said cord-circuit, normally open shunts around said supervisory lamps, said shunts being closed while the plugs are in the jacks and the line circuits closed, but said shunts being opened when the line circuits are broken, supervisory relays for controlling said shunts, and cut-out relays for restoring the line signals and establishing connection between the jacks and the lines, said cut-out relays being adapted to be energized by the insertion of the plugs in the jacks, each cut-out relay having one terminal permanently connected with the source of current connected with the cord circuit, and the other terminal of each cut-out relay being connected with the sleeve contact or thimble of the adjacent spring-jack.

29. In a telephone system, the combination of a subscriber's line, a line relay, a line signal operated by said relay, means for supplying current through the line circuit for initially energizing said relay, a normally open local circuit associated with said line signal, the coil and the normally separated contacts of said relay being included in said local circuit, the relay coil being also included in the line circuit, and means for calling over both sides of the line circuit.

30. In a telephone system, the combination of a subscriber's line circuit, a local circuit at the central exchange, means for supplying current through said circuits, a line relay responsive to calls and adapted for closing said local circuit, the coil of said relay being connected and arranged to form part of both line and local circuits, and a line lamp located in said local circuit.

31. In a telephone system, a substation and a central station and complete metallic line connection between the same, a lamp signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the line terminals at the central station, said short-circuit connection being normally open, and a calling device at the substation for operating said relay and thereby closing the said short-circuit, a cutting-out relay for opening up said short-circuit and cutting out said battery, a spring jack and a plug and cord circuit with a battery for operating said cut-out relay.

32. The combination with a telephone line and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet is placed under the control of the subscriber.

33. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said super-

visory apparatus, and a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack.

34. The combination with a telephone line, of a connection terminal normally disconnected therefrom, a relay for connecting said connection terminal with the line, a central source of current adapted to be connected in the metallic circuit for talking purposes, means for operating said relay from said source when connection is made with the line by current flowing over a path including a portion of the cord circuit, and means for sending a calling-current over the line of the called subscriber only and at the same time maintaining said relay in operated condition.

35. The combination with a telephone-line and a connection terminal therefor normally not in operative relation with the line, of a connecting plug and cord-circuit to coöperate with said line, a supervisory signal controlling magnet and battery associated with said cord-circuit, a telephone transmitter and a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing the jack in operative relation with the line by current flowing over a path including a portion of the cord-circuit, whereby talking current is furnished to said transmitter and said magnet is placed under the control of the subscriber.

36. The combination with a telephone line, and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a switch at the subscriber's station, and means including a contact connected with the cord circuit controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet is placed under the control of the subscriber.

37. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substations, and means including said source of current actuated by the insertion of said plug in the jack and by current flowing over a part of the cord circuit for placing said jack in operative relation with said line.

38. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, and a relay adapted to be energized from said source over a path including a portion of the cord circuit to place said jack in operative relation with the line when said plug is inserted in said jack.

39. The combination with a telephone line, and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, and a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack for controlling the operative relation of said jack with said line, said relay being actuated by current flowing over a portion of a strand of the cord circuit, a contact of the plug and jack.

40. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally not in operative relation with said line, a connecting plug and a cord circuit, a signaling device normally in operative relation with said line, a central source of current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, and a relay actuated from said source over a portion of the cord circuit when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line.

41. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, and for the operation of said supervisory apparatus, and means actuated over a portion of the cord circuit for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use.

42. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery to furnish current for talking purposes and for the operation of said apparatus, and a relay energized from said battery and connected directly to the cord circuit and adapted to disconnect said limb from said signaling device and to connect the same with the line contact when a connection is established with the line.

43. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes and for operating said supervisory signals, and a relay also energized from said battery over a circuit including a portion of the cord circuit and adapted to disconnect said spring or part from the signaling device and to connect it with the line contact when a connection is established with the line.

44. In a telephone system, the combination of a subscriber's line, a jack having line contacts both of which are normally disconnected from the line, a cord circuit and plug, a relay for connecting the jack with the line, and a battery for energizing said relay over a path including the sleeve of said plug and a strand of said cord circuit.

45. The combination of a subscriber's line, a jack having line contacts both of which are normally disconnected from the line, a relay for establishing connection between the jack and the line, a cord circuit and plug, and a battery for energizing said relay over a path including the sleeve contacts of said jack and plug.

46. The combination of a subscriber's line, a jack normally disconnected from the line, a relay for establishing connection between the line and said jack, a cord circuit and plug, a supervisory relay and a supervisory lamp associated with said cord circuit, and a battery for energizing both of said relays and lighting said lamp, the said first mentioned relay being energized over a path including said lamp.

47. A telephone system comprising a subscriber's line, both sides of which are normally disconnected from the spring jack, an electro magnet for an opening and closing connection between the line and spring jack, and a central source of current and an operator's cord strand included in the energizing circuit of said magnet.

48. The combination with a telephone line and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet is placed under the control of the subscriber, together with a supervisory or disconnecting circuit including both sides of said line in series, and a substation switch for opening said supervisory circuit to give a signal.

49. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, and a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack, together with a supervisory or disconnecting circuit including both sides of said line in series, and a substation switch for opening said supervisory circuit to give a signal.

50. In a telephone system, a subscriber's line, a line relay, a central source of electric current, a normally open line circuit for energizing said relay, and a normally open local circuit controlled by the said relay and including an energizing coil thereof, whereby the said local circuit is substituted for the said line circuit when the relay is energized, each circuit including said source of current, and the said apparatus thus provided including relay contacts controlling said line circuit, and an armature for operating said contacts.

51. In a telephone system, the combination of stations and line connection between the same, a calling device at one of said stations, a caling signal and a battery at the other station, a normally open local circuit including said battery, said battery being normally connected with the line, and a relay for closing said local circuit, the operation of said calling device causing the current of said battery to first flow over the line, and the energization of the relay then operating to transfer the current to said local circuit, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

52. In a telephone system, the combination of a substation and a central station, a line circuit connecting said substation and said central station, a calling device at said substation, a calling signal and a relay and a battery at the central station, a normally open local circuit including said battery and relay, said battery being normally connected with the line, said local circuit when closed by the relay operating to completely short-circuit the said substation, so as to permit the operator to answer a call without producing sounds in the receiver at said station, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

53. In a telephone system, the combination of a substation and a central station and suitable line connection between the same, a calling device at said substation, a calling signal at the central station, a relay and a battery at said central station, a normally open local circuit including said battery and relay, said relay and said calling signal being responsive to said calling device, and the local circuit when closed by the relay operating to hold or lock the calling signal in operation until the call is answered by the operator, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

54. In a telephone system, a substation and a central station and line connection between the same, a calling signal and a battery for operating the same at the central station, said battery and signal being normally connected with the line, the signal serving as medium of connection between the battery and line, a calling device at the substation for operating said calling signal, the line being normally open at the substation, and a normally open local circuit which closes when a call is sent in and which holds the calling signal in operation until restored by the operator, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

55. In a telephone system, a substation and a central station and normally open line connection between the same, a calling signal consisting of a lamp arranged to light when a call is sent in from the substation, a relay associated with said lamp, a suitable device at the substation for causing the operation of said calling signal, a battery at the central station for supplying current to said lamp, said battery being normally connected with the line through said relay and lamp, and a local circuit which is closed when a call is sent in and which affords a short circuit of comparatively low and unvarying resistance through which the current from said battery flows for the purpose of lighting said lamp, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

56. In a telephone system, a substation and a central station and a complete metallic line connection between the same, a spring jack and a plug and a cord circuit with a clearing-out signal, a complete metallic line circuit which is opened to operate said clearing-out signal, a calling signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the terminals of the line at the central station, said short-circuit connection being normally open, a local circuit including the battery and relay and short-circuit connection, and a calling device at the substation for operating said relay and thereby closing said short-circuit connection to exclude the signal current from the main line after a call is sent in, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

57. In a telephone system, a line circuit normally open at one station; a switch or like circuit-changer therefor at said station; a source of current, a relay, and a signal receiving device all at another station; and a normally open associated local circuit at said other station leading through the contact points of said relay and controlled thereby; the said source, relay, and signal device being in a section of conductor forming part of both line and local circuits; a normally disconnected jack; a relay individual to the line and adapted when energized to connect the jack therewith; an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

58. A telephone system comprising a substation and a central station with line connection, a battery and a local circuit at the central station, a relay for closing the current of said battery through said local circuit when a call is sent in, the battery being normally connected with the line through said relay, and the relay forming a part of both line and local circuits, a calling device at the substation for operating said relay, and a calling signal at the central station associated with said relay and operated by said battery, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

59. In a telephone system, the combination of a subscriber's line, a hook switch for opening and closing the line circuit, a battery normally connected with the line, a line relay for operating the line signal, a normally open short-circuit connection across the line terminals at the central station, said short-circuit connection being closed by the energization of the line relay when a call is sent in, and a local circuit including said battery relay and short-circuit connection, the said relay being located in a conductor forming part of both the line and local circuits, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local

energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

60. In a telephone system, the combination of a subscriber's line, a line relay, a line signal operated by said relay, means for supplying current through the line circuit for energizing said relay, and a normally open local circuit associated with said line signal, the coil and normally separated contacts of said relay being included in said local circuit, and the relay coil being also included in the line circuit, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

61. In a telephone system, the combination of a subscriber's line circuit, a local circuit at the central exchange, means for supplying current through said circuits, a line relay responsive to calls and adapted for closing said local circuit, the coil of said relay being connected and arranged to form part of both line and local circuits, and a line lamp located in said local circuit, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

62. A telephone system comprising a subscriber's line consisting of two metallic limbs, suitable substation apparatus, suitable central station apparatus, a normally open low resistance connection across the terminals of the two limbs at the central station, and a relay for closing said connection, said connection when closed operating to short-circuit the said substation apparatus, a normally disconnected jack, a relay individual to the line and adapted when energized to connect the jack therewith, an operator's connecting cord, and a local energizing circuit for said individual relay, said energizing circuit including a strand of said connecting cord.

63. In a telephone system, the combination of stations and line connection between the same, a calling device at one of said stations, a calling signal and a battery at the other station, a normally open local circuit including said battery, said battery being normally connected with the line, and a relay for closing said local circuit, the operation of said calling device causing the current of said battery to first flow over the line, and the energization of the relay then operating to transfer the current to said local circuit, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

64. In a telephone system, the combination of a substation and a central station, a line circuit connecting said substation and said central station, a calling device at said substation, a calling signal and a relay and a battery at the central station, a normally open local circuit including said battery and relay, said battery being normally connected with the line, said local circuit when closed by the relay operating to completely short-circuit the said substation, so as to remove battery current therefrom and permit the operator to answer a call without producing sounds in the receiver at said station, a supervisory relay, a complete metallic line circuit for energizing said supervisory relay, and a talking circuit including said calling device.

65. In a telephone system, the combination of a substation and a central station and suitable line connection between the same, a calling device at said substation, a talking circuit including said calling device a calling signal at the central station, a relay and a battery at said central station, a normally open local circuit including said battery and relay, said relay and said calling signal being responsive to said calling device, and the local circuit when closed by the relay operating to hold or lock the calling signal in operation until the call is answered by the operator, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay, from said battery.

66. In a telephone system, a substation and a central station and line connection between the same, a calling signal and a battery for operating the same at the central station, said battery and signal being normally connected with the line, the signal serving as medium of connection between the battery and line, a calling device at the substation for operating said calling signal, the line being normally open at the substation, and a normally open local circuit which closes when a call is sent in and which holds the calling signal in operation until restored by the operator, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

67. In a telephone system, a substation and a central station and normally open line connection between the same, a calling signal consisting of a lamp arranged to light when a call is sent in from the substation, a relay associated with said lamp, a suitable device at the substation for causing the operation of said calling signal, a battery at the central station for supplying current to said lamp, said battery being normally connected with the line through said relay and lamp, and a local circuit which is closed when a call is sent in and which affords a short circuit of comparatively low and unvarying resistance through which the current from said battery flows for the purpose of lighting said lamp, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

68. In a telephone system, a substation and a central station and a complete metallic line connection between the same, a spring jack and a plug and a cord circuit with a clearing-out signal, a complete metallic line circuit which is opened to operate said clearing-out signal, a calling signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the terminals of the line at the central station, said short-circuit connection being normally open, a local circuit including the battery and relay and short-circuit connection, and a calling device at the substation for operating said relay and thereby closing said short-circuit connection so as to exclude the signal current from the main line after a call is sent in, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

69. In a telephone system, a line circuit normally open at one station; a switch or like circuit-changer therefor at said station; a source of current, a relay, and a signal receiving device all at another station; and a normally open associated local circuit at said other station leading through the contact points of said relay and controlled thereby; the said source, relay, and signal device being in a section of conductor forming part of both line and local circuits; a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

70. A telephone system comprising a substation and a central station with line connection, a battery and a local circuit at the central station, a relay for closing the current of said battery through said local circuit when a call is sent in, the battery being normally connected with the line through a winding of said relay, and the relay winding and battery forming a part of both line and local circuits, a calling device at the substation for operating said relay, and a calling signal at the central station associated with said relay and operated by said battery, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

71. In a telephone system, the combination of a subscriber's line, a hook switch for opening and closing the line circuit, a battery normally connected with the line, a line relay for operating the line signal, a normally open short-circuit connection across the line terminals at the central station, said short-circuit connection being closed by the energization of the line relay when a call is sent in, and a local circuit including said battery relay and short-circuit connection, the said relay being located in a conductor forming part of both the line and local circuits, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

72. In a telephone system, the combination of a subscriber's line, a line relay, a line signal operated by said relay, means for supplying current through the line circuit for energizing said relay, and a normally open local circuit associated with said line signal, the coil and the normally separated contacts of said relay being included

in said local circuit, and the relay coil being also included in the line circuit, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

73. In a telephone system, the combination of a subscriber's line circuit, a local circuit at the central exchange, means for supplying current through said circuits, a line relay responsive to calls and adapted for closing said local circuit, the coil of said relay being connected and arranged to form part of both line and local circuits, and a line lamp located in said local circuit, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

74. A telephone system comprising a subscriber's line consisting of two metallic limbs, suitable substation apparatus, suitable central station apparatus, a normally open low resistance connection across the terminals of the two limbs at the central station, and a relay for closing said connection, said connection when closed operating to short-circuit the said substation apparatus, a supervisory relay, and a complete metallic line circuit for energizing said supervisory relay.

75. In a telephone system, the combination of stations and line connection between the same, a calling device at one of said stations, a calling signal and a battery at the other station, a normally open local circuit including said battery, said battery being normally connected with both sides of the line, and a relay for closing said local circuit, the operation of said calling device causing the current of said battery to first flow over both sides of the line, and the energizing of the relay then operating to transfer the current to said local circuit, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

76. In a telephone system, the combination of a substation and a central station, a line connecting said substation and said central station, a calling device at said substation, a calling signal and a relay and a battery at the central station, a normally open local circuit including said battery and relay, a line circuit closed while the subscriber is waiting for the operator to answer, and including the battery in series with the receiver at the substation, said battery being normally connected with the line, said local circuit when closed by the relay operating to completely shunt or short-circuit the said substation, to remove battery current therefrom and permit the operator to answer without producing sounds in the receiver at said station, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

77. In a telephone system, the combination of a substation and a central station and suitable line connection between the same, a calling device at said substation, a calling signal at the central station, a relay and a battery at said central station, a normally open local circuit including said battery and relay, said relay and said calling signal being responsive to said calling device, and the local circuit when closed by the relay operating to hold or lock the calling signal in operation until the call is answered by the operator, an operator's connecting cord, a talking circuit including both sides of the calling circuit, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

78. In a telephone system, a substation and a central station and line connection between the same, a calling signal and a battery for operating the same at the central station, said battery being normally connected with both sides of the line, the signal serving as medium of connection between the battery and one side of line, a calling device at the substation for operating said calling signal, the line being normally open at the calling device of the substation, and a normally open local circuit which closes in parallel with the line when a call is sent in and which holds the calling signal in operation until restored by the operator, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

79. In a telephone system, a substation and a central station and normally open line connection between the same, a calling signal consisting of a lamp arranged to light when a call is sent in from the substation, a relay associated with said lamp, a suitable device at the substation for causing the operation of said calling signal, a battery at the central station for supplying current to said lamp, said battery being normally connected with the line through said relay and lamp, and a local circuit which is closed when a call is sent in and which affords a short circuit of comparatively low and unvarying resistance through which the current from said battery flows for the purpose of lighting said lamp, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

80. In a telephone system, a substation and a central station and a complete metallic line connection between the same, a spring jack and a plug and a cord circuit with a clearing-out signal, a complete metallic line circuit which is opened to operate said clearing-out signal, a calling signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the terminals of the line at the central station, said short-circuit connection being normally open, a local circuit including the battery and relay and short-circuit connection, and a calling device at the substation for operating said relay and thereby closing said short-circuit connection so as to exclude the signal current from the main line after a call is sent in, an operator's connecting cord, and a supervisory relay under the control of the subscriber when the cord is connected with the line.

81. In a telephone system, a line circuit normally open at one station; a switch or like circuit-changer therefor at said station; a source of current, a relay, and a signal receiving device all at another station; and a normally open associated local circuit at said other station leading through the contact points of said relay and controlled thereby; the said source, relay, and signal device being in a section of conductor forming part of both line and local circuits; an operator's connecting cord; and a supervisory signal under the control of the subscriber when the cord is connected with the line.

82. A telephone system comprising a substation and a central station with line connection, a battery and a local circuit at the central station, a relay for closing the current of said battery through said local circuit when a call is sent in, the battery being normally connected with the line through a winding of said relay, and the relay winding and battery forming a part of both line and local circuits, a calling device at the substation for operating said relay, and a calling signal at the central station controlled by said relay and operated by said battery, an operator's connecting cord, a subscriber's transmitter in the line energizing circuit of said relay, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

83. In a telephone system, the combination of a subscriber's line, a hook switch for opening and closing the line circuit, a battery normally connected with the line, a line relay for operating the line signal, a normally open short-circuit connection across the line terminals at the central station, said short-circuit connection being closed by the energization of the line relay when a call is sent in, and a local circuit including said battery relay and short-circuit connection, the said relay being located in a conductor forming part of both the line and local circuits, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

84. In a telephone system, the combination of a subscriber's line, a transmitter a line relay, a line signal operated by said relay, means for supplying current through the transmitter and line circuit for initially energizing said relay, and a normally open local circuit associated with said line signal, the coil and the normally separated contacts of said relay being included in said local circuit, and the relay coil being also included in the line circuit in series with said transmitter, an operator's connecting cord, and a supervisory signal only under the control of the subscriber when the cord is connected with the line.

85. In a telephone system, the combination of a subscriber's line circuit, a local circuit at the central exchange, means for supplying current through said circuits,

a line relay responsive to calls and adapted for closing said local circuit, the coil of said relay being connected and arranged to form part of both line and local circuits, and a line lamp located in said local circuit, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

86. A telephone system comprising a subscriber's line consisting of two metallic limbs, suitable substation apparatus, suitable central station apparatus, a normally open low resistance connection across the terminals of the two limbs at the central station, and a relay for closing said connection, said connection when closed operating to short-circuit the said substation apparatus, an operator's connecting cord, and a supervisory signal under the control of the subscriber when the cord is connected with the line.

87. In a telephone system, the combination of stations and line connection between the same, a calling device at one of said stations, a calling signal and a battery at the other station, a normally open local circuit including said battery, said battery being normally connected with the line, and a relay for closing said local circuit, the operation of said calling device causing the current of said battery to first flow over the line, and the energization of the relay then operating to transfer the current to said local circuit, a subscriber's calling circuit for getting the attention of the operator, said circuit including a winding of said relay and both sides of the line in series.

88. In a telephone system, the combination of a substation and a central station, a line circuit connecting said substation and said central station, a calling device at said substation, a calling signal and a relay and a battery at the central station, a normally open bridge of practically no resistance across the line at the central station, a normally open local circuit including said battery and relay and bridge, said battery being normally connected with the line, said local circuit when closed by the relay operating to completely short-circuit the said substation, so as to take battery current away from the substation and permit the operator to answer a call without producing sounds in the receiver at said station, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

89. In a telephone system, the combination of a substation and a central station and suitable line connection between the same, a calling device at said substation, a calling signal at the central station, a relay and a battery at said central station, a normally open local circuit including said battery and relay, said relay and said calling signal being responsive to said calling device, and the local circuit when closed by the relay operating to hold or lock the calling signal in operation until the call is answered by the operator, a subscriber's calling circuit for getting the attention of the operator, said circuit including a winding of said relay and both sides of the line in series, a spring jack allotted to the calling subscriber, and a local circuit extending through the jack to retire the line signal when the operator answers.

90. In a telephone system, a substation and a central station and line connection between the same, a calling signal and a battery for operating the same at the central station, said battery and signal being normally connected with the line, the signal serving as medium of connection between the battery and line, a calling device at the substation for operating said calling signal, the line being normally open at the substation, and a normally open local circuit which closes when a call is sent in and which holds the calling signal in operation until restored by the operator, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

91. In a telephone system, a substation and a central station and normally open line connection between the same, a calling signal consisting of a lamp arranged to light when a call is sent in from the substation, a relay associated with said lamp, a suitable device at the substation for causing the operation of said calling signal, a battery at the central station for supplying current to said lamp, said battery being normally connected with the line through said relay and lamp, and a local circuit which is closed when a call is sent in and which affords a short circuit of comparatively low and unvarying resistance through which the current from said battery flows for the purpose of lighting said lamp, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

92. In a telephone system, a substation and a central station and a complete metallic line connection between the same, a spring jack and a plug and a cord circuit with a clearing-out signal, a complete metallic line circuit which is opened to operate said clearing-out signal, a calling signal and a relay and a battery for operating the same at the central station, a short-circuit connection between the terminals of the line at the central station, said short-circuit connection being normally open, a local circuit including the battery and relay and short-circuit connection, and a calling device at the substation for operating said relay and thereby closing said short-circuit connection so as to exclude the signal current from the main line after a call is sent in, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

93. In a telephone system, a line circuit normally open at one station; a switch or like circuit-changer therefor at said station; a source of current, a relay, and a signal receiving device all at another station; and a normally open associated local circuit at said other station leading through the contact points of said relay and controlled thereby; the said source, relay, and signal device being in a section of conductor forming part of both line and local circuits; a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

94. A telephone system comprising a substation and a central station with line connection, a battery and a local circuit at the central station, a relay for closing the current of said battery through said local circuit when a call is sent in, the battery being normally connected with one side of the line through a winding of said relay, and the relay winding forming a part of both line and local circuits, a calling device at the substation for operating said relay, a visual calling signal at the central station associated with said relay and operated by said battery, and a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

95. In a telephone system, the combination of a subscriber's line, a hook switch for opening and closing the line circuit, a battery normally connected with the line, a line relay for operating the line signal, a normally open short-circuit connection across the line terminals at the central station, said short-circuit connection being closed by the energization of the line relay when a call is sent in, and a local circuit including said battery relay and short-circuit connection, the said relay being located in a conductor forming part of both the line and local circuits, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

96. In a telephone system, the combination of a subscriber's line, a line relay, a line signal operated by said relay, means for supplying current through the line circuit for energizing said relay, and a normally open local circuit associated with said line signal, the coil and the normally separated contacts of said relay being included in said local circuit, and the relay coil being also included in the line circuit, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

97. In a telephone system, the combination of a subscriber's line circuit, a local circuit at the central exchange, means for supplying current through said circuits, a line relay responsive to calls and adapted for closing said local circuit, the coil of said relay being connected and arranged to form part of both line and local circuits, and a line lamp located in said local circuit, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

98. A telephone system comprising a subscriber's line

consisting of two metallic limbs, suitable substation apparatus, suitable central station apparatus, a normally open low resistance connection across the terminals of the two limbs at the central station, and a relay for closing said connection, said connection when closed operating to short-circuit the said substation apparatus, a subscriber's calling circuit for getting the attention of the operator, said circuit including both sides of the line in series.

99. The combination with a telephone line and a connection terminal therefor normally not in operative relation with the line, of a connecting plug and cord circuit to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a telephone transmitter and a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing the jack in operative relation with the line, whereby talking current is furnished to said transmitter and said magnet is placed under the control of the subscriber, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

100. The combination with a telephone line and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet is placed under the control of the subscriber, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

101. The combination with a telephone line, and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substations, and means including said source of current actuated by the insertion of said plug in the jack for placing said jack in operative relation with said line, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

102. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, and a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

103. The combination with a telephone line and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, and a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack for controlling the operative relation of said jack with said line, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

104. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally not in operative relation with said line, a central source of current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, and a relay actuated from said source when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

105. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes and for the operation of said supervisory apparatus, and means for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

106. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said line normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery to furnish current for talking purposes and for the operation of said apparatus, and a relay energized from said battery adapted to disconnect said limb from said signaling device and to connect the same with the line contact when a connection is established with the line, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

107. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes and for operating said supervisory signals, and a relay also energized from said battery adapted to disconnect said spring or part from the signaling device and to connect it with the line contact when a connection is established with the line, a normally open low resistance connection bridged across the line at the central station, and means for closing said connection to short-circuit or shunt the line when the subscriber calls.

108. The combination with a telephone line and a connection terminal therefor normally not in operative relation with the line, of a connecting plug and cord circuit to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a telephone transmitter and a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing the jack in operative relation with the line, whereby talking current is furnished to said transmitter and said magnet is placed under the control of the subscriber, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

109. The combination with a telephone line and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet is placed under the control of the subscriber, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

110. The combination with a telephone line, and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a

connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substations, and means including said source of current actuated by the insertion of said plug in the jack for placing said jack in operative relation with said line, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

111. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, and a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

112. The combination with a telephone line and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, and a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack for controlling the operative relation of said jack with the line, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

113. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally not in operative relation with said line, a connecting plug and a cord circuit, a signaling device normally in operative relation with said line, a central source of current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, and a relay actuated from said source when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

114. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes and for the operation of said supervisory apparatus, and means for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

115. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said line normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery to furnish current for talking purposes and for the operation of said apparatus, and a relay energized from said battery adapted to disconnect said limb from said signaling device and to connect the same with the line contact when a connection is established with the line, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

116. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes and for operating said supervisory signals, and a relay also energized from said battery, adapted to disconnect said spring or part from the signaling device and to connect it with the line contact when a connection is established with the line, a local circuit for short-circuiting or shunting the line when the subscriber calls, and means for opening said local circuit when a connection is made with the line.

117. The combination with a telephone line and a connection terminal therefor normally not in operative relation with the line, of a connecting plug and cord circuit to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a telephone transmitter and a switch at the subscriber's station, and means including a local circuit controlled by the insertion of the plug into the jack for placing the jack in operative relation with the line when the subscriber calls, whereby talking current from said battery is furnished to said transmitter and said magnet is placed under the control of the calling subscriber, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

118. The combination with a telephone line and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery for energizing the same associated with said cord circuit, a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet and battery are placed under the control of the subscriber, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

119. The combination with a telephone line, and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substation, means independent of said line, including said source of current, actuated by the insertion of said plug in the jack, for placing said jack in operative relation with said line, when the operator answers a call, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

120. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, and a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

121. The combination with a telephone line and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack, for controlling the operative relation of said jack with said line, a local circuit closed to keep said relay energized while the line is in use for talking purposes, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

122. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally

not in operative relation with said line, a connecting plug and a cord circuit, a signaling device normally in operative relation with said line, a central source of current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, a relay actuated from said source when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line, a local circuit closed to keep said relay energized while the line is in use for talking purposes, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

123. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes and for the operation of said supervisory apparatus, means for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

124. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said line normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery to furnish current for talking purposes and for the operation of said apparatus, a relay energized from said battery and adapted to disconnect said limb from said signaling device and to connect the same with the line contact when a connection is established with the line, a local circuit including a cord strand for energizing said relay when the line is in use for talking purposes, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

125. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes, and for operating said supervisory signals, and a relay also energized from said battery adapted to disconnect said spring or part from the signaling device and to connect it with the line contact when a connection is established with the line, a subscriber's bell or ringer, a source of ringing current adapted to be bridged across the line to operate said bell or ringer, and a ringing circuit including both sides of the line.

126. The combination with a telephone line and a connection terminal therefor normally not in operative relation with the line, of a connecting plug and cord circuit to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a telephone transmitter and a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing the jack in operative relation with the line, whereby talking current is furnished to said transmitter and said magnet is placed under the control of the subscriber, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit.

127. The combination with a telephone line, and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substation, and means including said source of current actuated by the insertion of said plug in the jack for placing said jack in operative relation with said line, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit.

128. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack, means independent of said relay for normally connecting the battery with both sides of the line, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit.

129. The combination with a telephone line and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, and a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack for controlling the operative relation of said jack with said line, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit.

130. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally not in operative relation with said line, a connecting plug and a cord circuit, a signaling device normally in operative relation with said line, a central source of current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, and a relay actuated from said source when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit.

131. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes and for the operation of said supervisory apparatus, and means for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit.

132. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said line normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery and means operated thereby to disconnect said limb from said signaling device and connect the same with the line contact when a connection is established with the line, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be rendered operative by the opening of said energizing circuit, said plug having a tip contact adapted to engage said normally disconnected line contact.

133. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes and for operating said supervisory signals, and a relay also energized from said battery adapted to disconnect said spring or part from the signaling device and to connect it with the line contact when a connection is established with the line, a supervisory magnet energizing circuit including both sides of the line, and a supervisory lamp circuit adapted to be closed by the opening of said energizing circuit.

134. The combination with a telephone line and a spring jack therefor normally totally disconnected therefrom, of a connecting plug and cord circuit to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a telephone transmitter and a switch at the subscriber's station, means controlled by the insertion of the plug into the jack for placing the jack in connection with the line, said means including a local circuit closed by the plug and jack while the line is in use for talking purposes, whereby talking current is furnished to said transmitter and said magnet is placed under the control of the subscriber, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

135. The combination with a telephone line and a spring jack therefor normally totally disconnected therefrom, of a connecting plug and cord circuit adapted to coöperate with said jack, a supervisory signal controlling magnet and a battery associated with said cord circuit, a switch at the subscriber's station, means controlled by the insertion of the plug into the jack for placing said jack in connection with the line, whereby said signal controlling magnet is placed under the control of the subscriber, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

136. The combination with a telephone line, and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substations, and means including said source of current and actuated by the insertion of said plug in the jack for placing said jack in operative relation with said line, said means comprising a local circuit closed over a cord strand while the line is in use for talking purposes, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

137. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into said jack, a local circuit closed through said relay while the line is in use for talking purposes, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

138. The combination with a telephone line and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, and a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack for controlling the operative relation of said jack with said line, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

139. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally not in operative relation with said line, a connecting plug and a cord circuit, a line signaling device normally in operative relation with said line, a central source of battery current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, and a relay actuated from said source when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line, a line signaling circuit excluding all winding of said relay, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

140. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes and for the operation of said supervisory apparatus, and means independent of the line outside the central station for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

141. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said line normally disconnected thereform, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery to furnish current for talking purposes and for the operation of said apparatus, and a relay energized from said battery adapted to disconnect said limb from said signaling device and to connect the same with the line contact when a connection is established with the line, a normally open local energizing circuit for said relay, closed when the operator answers a call, a subscriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

142. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes and for operating said supervisory signals, and a relay also energized from said battery adapted to disconnect said spring or moving part from the signaling device and to connect it with the line contact when a connection is established with the line, the line connection with the battery excluding all winding of the said relay, a sub-

seriber's bell or ringer, and a condenser for stopping the flow of battery current through said bell or ringer, together with provisions by which the supervision is independent of the ground between the subscriber's station and the central station.

143. The combination with a telephone line and a connection terminal therefor normally not in operative relation with the line, of a connecting plug and cord circuit to coöperate with said line, a supervisory signal controlling magnet and a battery associated with said cord circuit, a telephone transmitter and a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing the jack in operative relation with the line, whereby talking current is furnished to said transmitter and said magnet is placed under the control of the subscriber, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

144. The combination with a telephone line and a connection terminal therefor normally not in operative relation with said line, of a connecting plug and cord circuit adapted to coöperate with said line, a supervisory signal controlling magnet and a battery for energizing the same associated with said cord circuit, a switch at the subscriber's station, and means controlled by the insertion of the plug into the jack for placing said jack in operative relation with the line, whereby said signal controlling magnet and battery are placed under the control of the subscriber, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

145. The combination with a telephone line, and a connection terminal in the form of a spring jack normally not in operative relation with the line, of a cord circuit and a connecting plug, a central source of current associated with said line and circuit to furnish talking current to the substations, and means including said source of current actuated by the insertion of said plug in the jack for placing said jack in operative relation with said line, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

146. The combination with a telephone line and a connection terminal in the form of a spring jack normally not in operative relation with said line, of a cord circuit and connecting plug, supervisory signaling apparatus associated with said circuit, a central source of current associated with said line and circuit to operate said supervisory apparatus, and a relay adapted to be energized from said source to place said jack in operative relation with the line when said plug is inserted into the said jack, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

147. The combination with a telephone line and a connection terminal in the form of a spring jack, of a connecting plug and a cord circuit, a central source of current associated with said line and circuit to furnish current for talking purposes, supervisory signal apparatus associated with the cord circuit and operated from said source of current, and a relay actuated from said source by the insertion of said plug into and its withdrawal from said jack for controlling the operative relation of said jack with said line, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

148. In a telephone system, a metallic circuit line, a connection terminal in the form of a spring jack normally not in operative relation with said line, a connecting plug and a cord circuit, a signaling device normally in operative relation with said line, a central source of current and supervisory signaling apparatus associated with said line and cord circuit, said source being adapted to furnish current for the operation of said apparatus and for talking purposes, and a relay actuated from said source when said plug is inserted in said jack to place said signaling device in inoperative relation with said line and said jack in operative relation with said line, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

149. The combination with a telephone line having a limb extending to the central station, of a line contact for said limb normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus connected with said circuit, a central source of current associated with said line and circuit to furnish current for talking purposes and for the operation of said supervisory apparatus, and means for automatically connecting said line contact with said limb when the line is in use and for disconnecting the same therefrom when the line is not in use, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

150. The combination with a telephone line having a limb extending to the central station, of a signaling device normally connected with said limb, a line contact for said line normally disconnected therefrom, a cord circuit and connecting plug, supervisory signaling apparatus associated with said cord circuit, a central battery to furnish current for talking purposes and for the operation of said apparatus, a relay energized from said battery, adapted to disconnect said limb from said signaling device and to connect the same with the line contact when a connection is established with the line, and an energizing circuit for said signaling device, said relay provided with a winding excluded from the said energizing circuit, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

151. The combination with a telephone line having a limb extending to the central station, of a spring or moving part with which said limb connects at the central office, a signaling device connected with said spring or part in its normal position, a line contact for said limb, a cord circuit and connecting plug, a central battery associated with the said line circuit, supervisory signals also associated with the circuit, said battery being adapted to furnish current to the substations for talking purposes and for operating said supervisory signals, a relay also energized from said battery, adapted to disconnect said spring or part from the signaling device and to connect it with the line contact when a connection is established with the line, and an energizing circuit for said signaling device, said relay provided with a winding excluded from the said energizing circuit, the supervision being absolutely independent of the ground between the subscriber's station and the central station.

152. In a telephone system, a subscriber's line, a line relay, a source of electric current, a normally open line circuit for energizing said relay, and a normally open local circuit controlled by the said relay and including an energizing coil thereof, whereby the said local circuit is substituted for the said line circuit when the relay is energized, each circuit including said source of current, said line circuit including both sides of the line in series.

153. In a telephone system, a subscriber's line, a line relay, a source of electric current, a normally open line circuit for energizing said relay, and a normally open local circuit controlled by the said relay and including an energizing coil thereof, whereby the said local circuit is substituted for the said line circuit when the relay is energized, each circuit including said source of current, said line circuit being provided with normally closed relay contacts for opening the same.

154. In a telephone system, a subscriber's line, a line relay, a source of electric current, a normally open line circuit for initially energizing said relay over both sides of the line, and a normally open local circuit controlled by the said relay and including an energizing coil thereof, whereby the said local circuit is substituted for the said line circuit when the relay is energized, each circuit including said source of current, and a subscriber's hook switch controlling the said line circuit at the subscriber's station.

155. The combination of a telephone line, a substation at one end of said line, a low resistance connection between the limbs of the line at the other end thereof, and a relay for controlling the continuity of said connection, the resistance of said connection being sufficiently low to short-circuit or shunt the line and thereby quiet the same at the substation.

156. The combination of a plurality of subscriber's telephone lines, a substation for each line, normally dis-

connected jacks for said lines, metallic line signal and supervisory signal circuits between the exchange and the substations, metallic talking and ringing circuits between the exchange and substations, a common battery for supplying talking and signaling currents to the lines, a generator for supplying ringing currents to the lines, relays for connecting the jacks with the lines, an operator's cord and plugs for connecting lines together, and energizing circuits for said relays including portions of the cord, service between lines and the operations of all said instrumentalities being independent of the ground at substations.

157. The combination of a substation, a normally open metallic telephone talking circuit, a normally open metallic ringing circuit, a normally open metallic supervisory signal circuit, a subscriber's transmitter in said signal circuit, a normally open line signal circuit which includes opposite or parallel portions of the metallic talking circuit, a common battery included in all of said circuits except the ringing circuit, a generator for said ringing circuit, and a jack having a pair of disconnected line contacts included in all of said circuits except the line signal circuit, together with means operated by said battery for automatically connecting said contacts with the talking circuit when the operator answers a call emanating from said substation.

158. The combination of a subscriber's telephone line, a jack or switchboard terminal individual to said line and normally disconnected therefrom, a subscriber's common battery transmitter and hook switch, a common battery adapted to supply current to the line for both talking and signaling purposes, a line signal relay, an energizing circuit for said line relay including said battery and line and hook switch and transmitter, a cut-off relay for automatically retiring the line signal and connecting the jack with the line when the operator answers a call, an operator's connecting cord and plugs, an energizing circuit for said cut-off relay including said battery and a portion of said connecting cord, a supervisory signal relay, an energizing circuit for said supervisory relay including the said transmitter and hook switch, both sides of the line, normally disconnected contacts of the jack, the battery and a portion of the said cord, said battery permanently bridged between the talking strands of the connecting cord and normally bridged between the normally disconnected limbs of said line, a subscriber's call bell or signal, a ringing generator, an operator's switch for bridging said generator between the talking strands of the cord to operate the said call bell or signal, another subscriber's line terminal adapted to be connected with said first-mentioned line through the medium of said cord and plugs, a complete metallic circuit for energizing said bell or signal, another supervisory signal relay, and an energizing circuit for said last-mentioned supervisory relay, which energizing circuit is opened by said operator's switch when the generator is used for operating the subscriber's call bell or signal.

Signed by me at Chicago, Cook county, Illinois, this 22nd day of October 1901.

HENRY P. CLAUSEN.

Witnesses:

CHAS. C. BULKLEY,

HARRY P. BAUMGARTNER.