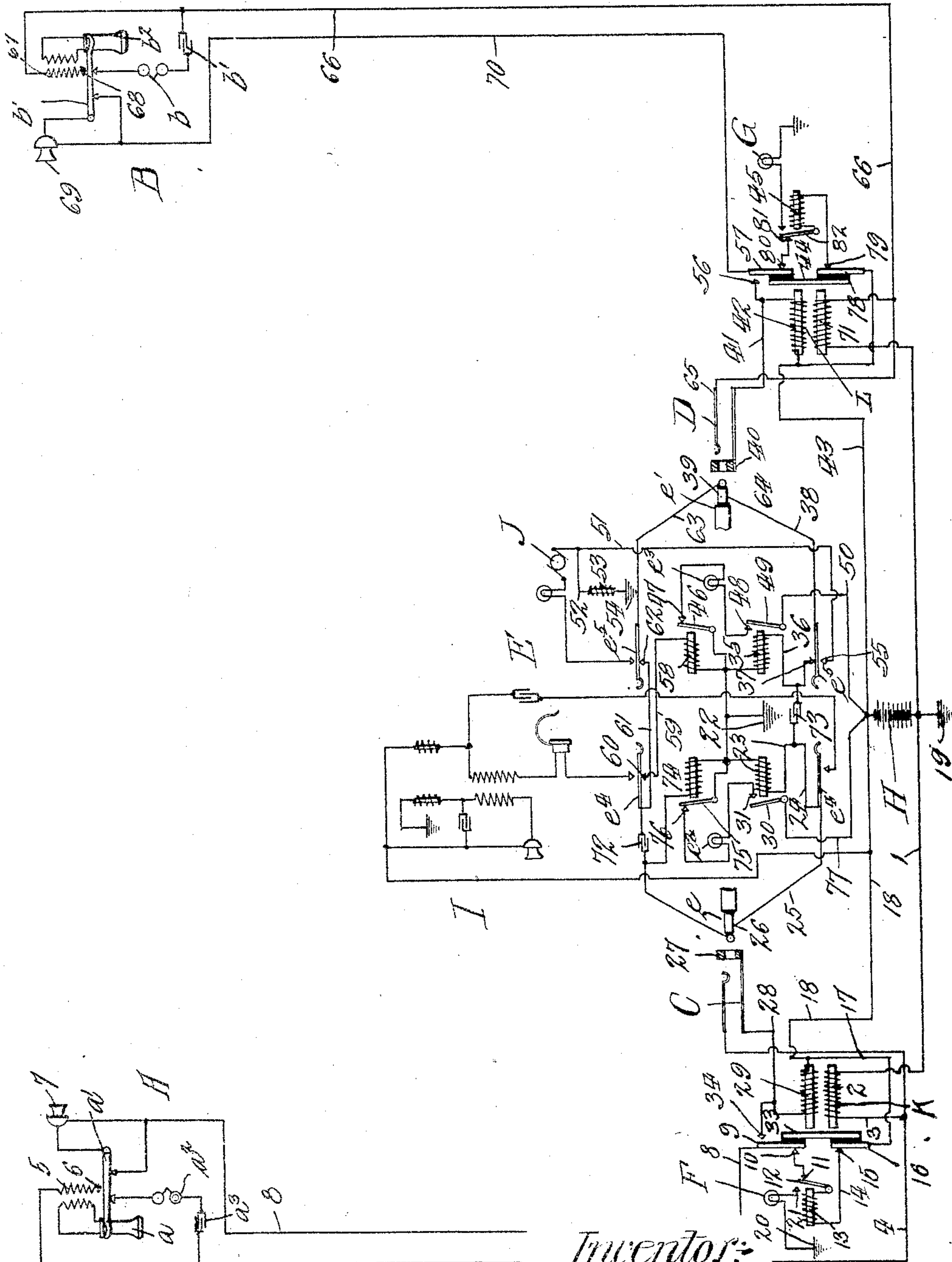


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TELEPHONE SYSTEM.
APPLICATION FILED JULY 24, 1903.

1,035,159.

Patented Aug. 13, 1912.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,035,159.

Specification of Letters Patent.

Patented Aug. 13, 1912.

Application filed July 24, 1903. Serial No. 166,795.

To all whom it may concern:

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

My invention relates to telephone systems of that type in which all of the current, both for signaling and talking purposes, is supplied from a common battery or centralized source of current supply located at the exchange or central station.

It also relates, more particularly, to telephone systems of that character in which complete metallic line connection is employed between the sub-stations and the exchange or central station. In systems of this type it is also usually the practice to employ line lamp signals for enabling the subscribers to call-in and attract the attention of the operators, and to also employ supervisory or clearing-out signals whereby the subscribers may signal for a disconnection. These lamp signals are usually mounted on the switchboard and are preferably controlled by line and supervisory relays. With this arrangement, the line lamp signals respond when the subscribers call-in by removing their receivers from the switch hooks, and the supervisory signals respond when the subscribers hang up or replace their receivers after having finished their conversation.

Generally stated, the object of my invention is the provision of an improved and highly efficient telephone system of the foregoing character.

A special object is the provision of an improved circuit arrangement whereby only two wires or conductors are necessary for each spring jack with which the different lines are connected at the switchboard, and also for each cord circuit by which connection is established between the different lines.

Another object is to provide an improved construction of line signal apparatus—that is to say, an improved construction of that portion of the apparatus by which the subscribers call-in and attract the attention of the operators.

It is also an object to provide certain details and features of improvement tending

to increase the general efficiency and service-ability of a common battery telephone system of this particular character.

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

The accompanying drawing is a diagram illustrating a common battery telephone system embodying the principles of my invention, only two sub-stations and one operator's cord circuit being shown. It being understood, however, that the system may involve as many sub-stations as the size and growth of the exchange demands, and as many operators' cord circuits as are necessary in order to enable the operators to establish the connections with facility and promptness.

As thus illustrated, my improved common battery telephone system comprises sub-stations A and B, the former connected by two parallel limbs or line conductors with a spring jack C, and the latter being likewise connected with a spring jack D, the two jacks being located on the switch-board at the exchange or central station. The system also involves an operator's cord circuit E, provided with answering and calling plugs e and e^1 , and thus adapted for establishing connection between the said lines. A line signal F is associated with the jack C, whereby subscriber A may attract the attention of the operator when he desires to talk with some other subscriber. In a similar manner and for a similar purpose, a line lamp G is associated with the jack D. As will be observed, supervisory lamp signals e^2 and e^3 are provided and associated with the operator's cord circuit. These supervisory signals, which are controlled by suitable relays, and by the switch-hooks at the sub-stations, enable the subscribers to signal the operator for a disconnection. All of the current, both that which is employed for talking and that which is employed for signaling purposes, is supplied from a common battery or centralized source of supply H. The line lamp signals are also controlled by suitable line and cut-off relays, and by the said switch-hooks. The said jacks and plugs are also adapted, as will hereinafter more fully appear, to have a certain amount of control over the said signals. The nature of my invention will, however, be more fully

understood by considering the manner in which the operator establishes connection between the two lines.

Suppose, for example, that subscriber A
 5 desires to talk with subscriber B. In such case, subscriber A removes his receiver a from the the switch-hook a^1 , and in so doing closes a line circuit from the battery H through the conductor 1, through the coil 2
 10 of the cut-off relay, through the conductor 3 and the limb or line conductor 4, through the winding 5 of the inductive connection between said receiver and the line circuit, through the contact 6 and the said switch-
 15 hook a^1 , through the transmitter 7, through the other limb or line conductor 8, thence through the armature contact 9 and the stationary contact 10 of the cut-off relay, through the contact 11 and the armature 12
 20 of the line relay, through the coil 13 of said line relay, through the conductor 14, through the stationary contact 15 and the armature contact 16 of the said cut-off relay, thence through the conductor 17, and through the
 25 conductor 18 to said battery. The current flowing through this circuit is sufficient to energize the relay 13, and the relative resistances are such that this line relay is energized and the circuit thereby opened be-
 30 fore the current has time to energize the cut-off relay. The armature 12 when attracted by the magnet of the line relay 13, opens the circuit of the coil 2, and at the same time closes a local circuit from the
 35 battery H through the ground or common connections 19 and 20, through the line lamp signal F, through the contact point 21, through the armature 12, through the coil 13 of the line relay, thence through the con-
 40 ductor 14 and the contact 15, through the armature contact 16, and thence through the conductors 17 and 18 to said battery. Thus, as stated, the line relay opens the line circuit before the current has time to energize the
 45 cut-off relay, and in so doing closes the local circuit of the line lamp and causes the latter to glow. The operator observing this signal inserts the plug e in the jack C. This closes a local circuit from the battery H
 50 through the ground or common connections 19 and 22, through the coil of the supervisory relay 23, through the conductor 24, through the talking strand 25, through the plug sleeve 26, through the ring or thimble
 55 27 of said jack, thence through the conductor 28 and the coil 29 of the cut-off relay, and through the conductor 18 to said battery. The current flowing in this derived circuit energizes the relay 23 and also the
 60 said cut-off relay. The relay 23 then pulls up its armature 30 and causes the same to engage the contact 31, thereby closing the normally open switch point in the circuit of the supervisory lamp e^2 . The energizing
 65 of the cut-off relay attracts the armature 33,

and in so doing separates the contacts 15 and 16, thereby opening the local circuit of the relay 13 and the line lamp signal F. In addition, the energizing of the cut-off relay through this derived circuit causes the arma-
 70 ture contact 9 to engage the stationary contact 34, thereby closing the normally open switch point in one side of the talking circuit between the jack C and substation A. It will also be observed that this energizing
 75 of the cut-off relay separates the contacts 9 and 10. The closing of the contacts 9 and 34 not only establishes the continuity of the talking circuit, but also closes a line circuit including the battery and including
 80 both of the coils 2 and 29. In this way the cut-off relay is fully energized and keeps its armature in the proper position during conversation between the subscribers. The operator then presses her listening key e^4 ,
 85 so as to bridge her talking set I across the cord circuit. She then converses with the calling subscriber and learns the number of the desired connection. After this, she can then insert the calling plug e^1 in the jack
 90 D. This act on the part of the operator establishes a derived circuit from the battery H through the ground or common connections 19 and 22, through the supervisory relay 35, through the conductor 36, through the
 95 contact 37 and the ringing key e^5 , thence through the talking strand 38, through the plug or thimble 40 of jack D, thence through the conductor 41, through the coil 42 of the cut-off relay L associated with the called
 100 subscriber's line, and through the conductor 43 to said battery. This energizes the said cut-off relay, causing it to attract its armature 44, and to thereby open a switch point in the derived local circuit of the lamp G
 105 and the line relay 45. In this way the operator places the line signal apparatus in such condition that subscriber B can answer the call without causing the lamp G to glow. The current flowing through this circuit
 110 causes the relay 35 to attract its armature and thereby close a local circuit from the battery H through the ground or common connections 19 and 22, through the armature 46 and the contact 47, through the super-
 115 visory lamp e^3 , through the contact 48 and the armature 49, and through the conductor 50 to said battery. The current flowing through this local circuit is sufficient to light the said lamp e^3 . Except possibly with the
 120 exception of the brief interval in which the operator is projecting ringing current on to the called subscriber's line for the purpose of ringing the bell at sub-station B, this lamp e^3 continues to glow until the sub-
 125 scriber at this sub-station answers the call. The operator calls the subscriber at sub-station B by pressing her ringing key e^5 , so as to bridge the generator J across the cord circuit. It will be observed that the
 130

relay 42 can be maintained in its energized condition during this projection of ringing current on to the called subscriber's line, by simply providing the generator bridge 51 with a ground tap 52 containing an impedance coil 53. With this arrangement the pressing of the said ringing key completes a circuit from the battery H through the ground or common connections 19 and 54, through the said impedance coil 53 and the conductors 52 and 51, through the contact 55, through the said ringing key, through the talking strand 38, through the plug sleeve 39 and the ring or thimble 40 of the jack, thence through the conductor 41 and the coil 42 of the cut-off relay, and thence through the conductor 43 to said battery. In this way the pressing of the ringing key establishes a temporary derived circuit for maintaining the cut-off relay in an energized condition, so as to keep the contacts 56 and 57, through which the ringing current must pass in order to be of use, in a closed condition. The current from the generator J rings the bell *b* at sub-station B. This bell is preferably in series with the condenser *b*¹, which latter stops the flow of battery current, but at the same time permits the passage of the alternating current from the generator. At this juncture it will also be seen that the bell *a*² is arranged in series with a condenser *a*³ at sub-station A. The subscriber at sub-station B responds by removing his receiver *b*² from the switch hook *b*¹, thereby closing a line circuit from the battery H through the connections 19 and 22, through the supervisory relay 58, through the conductor 59, through the contact 60 and the listening key *e*⁴, through the conductor 61 and the contact 62, through the ringing key *e*⁵ and the talking strand 63, through the plug tip 64 and the jack spring 65, through the conductor 66, through the winding 67 of the inductive connection between the receiver *b*² and the line circuit, through the contact 68, through the switch hook *b*¹, through the transmitter 69, through the line conductor 70, through the contacts 57 and 56, through the coil 42 of the cut-off relay, and thence through the conductor 43 to said battery. It will also be observed that the called subscriber in answering the call completes a line circuit including the coil 71 of the cut-off relay associated with this line. In other words, the relays 58 and 71 are placed in parallel. The energizing of the relay 58 opens the normally closed switch point composed of the armature 46 and the contact 47 in the local circuit of the lamp *a*², thereby causing the latter to cease glowing. In this way the called subscriber in answering the call restores the supervisory signal and thereby advises the operator that he has responded and is in communication with the calling subscriber. The through talk-

ing circuit thus established between the two subscribers includes, it will be observed, the limbs of the two lines, the plug and jack contacts, and the talking strands of the cord circuit, the latter being preferably provided with condensers 72 and 73. During conversation current is supplied to this talking circuit through the coils 2 and 29 and 71 and 42, which in this way act as resistance to regulate the current supply. Furthermore, as these coils are provided with cores, so that they may also act as cut-off relays, it will be seen that they have the further function of acting as impedance or retardation to prevent the passage of voice currents. The relays in the cord circuit, although bridged across the cord circuit, are of substantially high impedance or retardation to prevent the passage through them of the voice currents traversing the talking circuit.

When the subscribers have finished their conversation, and have hung up their receivers, the opening of the line circuits causes the lamps *e*² and *e*³ to glow. Suppose, for example, that subscriber A hangs up his receiver first. The opening of the line circuit leading from this sub-station opens the circuit of the supervisory relay 74, it being observed that during conversation this relay has remained energized, owing to its being connected at such time in parallel with the coil 2. This relay 74 when de-energized completes a local circuit from the battery H through the connections 19 and 22, through the armature 75 and the contact 76, through the lamp *e*², through the contact 31 and the armature 30, and through the conductor 77 to said battery. This causes the lamp *e*² to glow and thereby give the signal for disconnection. In a similar manner the subscriber at sub-station B in hanging up his receiver opens the line circuit, de-energizes the relay 58, and thus closes the previously described circuit of the lamp *e*³. The said lamp then responds to the flow of current and gives the signal for disconnection at this end of the cord circuit. The operator, upon withdrawing the plugs from the jacks, opens the circuits of the relays 23 and 35, and thus restores the lamps *e*² and *e*³. The withdrawal of the plugs in this manner also, of course, de-energizes the coils 29 and 42 of the two cut-off relays, allowing the latter to reestablish the normally open switch points in the two line circuits. It also reestablishes the normally closed shunts around these two switch points, but inasmuch as the line circuits are open at the sub-stations, the de-energizing of the cut-off relays in this manner does not cause the line lamps to glow. This is due, it will be seen, to the fact that no battery current can flow through the relays 43 and 45 when the circuits are open at the sub-stations. At this juncture, it will be seen that the coils 43 and

29, the contacts 15 and 16, the armature 12 and the contact 11, and the contacts 10 and 9 constitute normally closed shunts around the normally open switch point composed of the contacts 9 and 34. This shunt, it will be seen, is thus not only controlled by the cut-off relay K, but also by the line relay 13. In this way the said line relay is adapted to form part of both line and local circuits, and to automatically open the subscriber's line circuit and simultaneously therewith close the circuit of the lamp F. Thus there is no current on the subscriber's line when the operator plugs-in and cuts the battery off from the line signal, and consequently the operator can answer the call without producing an objectionable noise in the receiver at sub-station A. In other words, the arrangement tends to quiet the line in answering calls. In a similar way the coil 42 and the coil 45, contacts 78 and 79, the contacts 80 and 81, and the contact 57 and the armature 82, constitute a normally closed shunt around the normally open switch point composed of the contacts 56 and 57. The coil of the line relay 45 is adapted to serve as part of both line and local circuits, and this relay is adapted, like the relay 13, to automatically open the line circuit and simultaneously therewith close the local circuit of the lamp G when the subscriber at sub-station B calls-in. In other words, the line signal apparatus at this side of the circuit is substantially the same as the line signal apparatus allotted to the line leading from sub-station A.

It will be seen that with my improved apparatus only two wires or conductors are necessary for each jack, and that only two strands are necessary for the cord circuit, notwithstanding the fact that my improved system is characterized by the most approved methods of operation with respect to signaling and supervision, and also with respect to current supply and the manner in which the connections are established.

It is obvious that the resistances of the various relays can be adjusted or regulated to suit the conditions of any particular case, and can be varied within limits and to an extent which will not be inconsistent with their functions and mode of operation. It is also obvious that the feature of having the relays 13 and 45 more responsive than the coils 2 and 71 of the cut-off relays, can be accomplished in any suitable manner. For example, this can be done by a suitable adjustment or regulation of the resistances of the different coils, so as to have the coils 2 and 71 insure a more sluggish action or energizing of the cut-off relays than that of the line relays. Again, the cut-off relays can be given a tighter adjustment, or can be so mechanically constructed that the line relays will pull up and break the circuits

of the coils 2 and 71 before the cut-off relays can become energized. In other words, any suitable expedient can be employed for enabling the line relays to respond quickly and in such manner as to open the circuits of the coils 2 and 71 and close the circuits of the lamps F and G before the cut-off relays can become sufficiently energized to attract their armatures and open the switch points which they themselves control in the circuits of the line relays.

Other advantages will be obvious to those skilled in the art.

What I claim as my invention is:

1. A telephone system comprising a subscriber's line, a subscriber's switch for opening and closing the line circuit, a central source of current, a line relay provided with normally closed and normally open contacts, a line lamp signal, and suitable circuit connections whereby the coil of said relay and its said normally closed switch contacts are included in a line circuit when the subscriber calls-in, and whereby the said lamp signal and normally open contacts are then included in a closed local circuit by the energizing of the said relay.

2. A telephone system comprising a subscriber's line, a line relay and means for energizing it, said relay being provided with normally closed contacts through which the coil of said relay is adapted to be initially energized and a local energizing circuit for said relay adapted to be closed by the energizing of the same.

3. A telephone system comprising a subscriber's line, suitable sub-station apparatus, and suitable switchboard apparatus, the latter apparatus including a line relay adapted when energized to open the line circuit by which it is energized.

4. A telephone system comprising a subscriber's line, suitable sub-station apparatus, and suitable switchboard apparatus, the latter apparatus including a line relay having normally closed contacts adapted to serve as part of the initial energizing circuit of said relay and a local energizing circuit for said relay adapted to be closed by the energizing of the same.

5. A telephone system comprising a subscriber's line, suitable sub-station apparatus, and switchboard apparatus, the latter apparatus including a line relay and a cut-off relay, said relays having normally closed contacts connected normally in series with the coils of said relays, and also in series with said line.

6. A telephone system comprising a subscriber's line, suitable sub-station apparatus, and switchboard apparatus, the latter apparatus including line and cut-off relays, said cut-off relay having a coil adapted to serve as part of the initial energizing circuit of said line relay and a local energizing

circuit for said relay adapted to be closed by the energizing of the same.

7. A telephone system comprising a subscriber's line, suitable sub-station apparatus, and switchboard apparatus, the latter apparatus including line and cut-off relays, said relays having normally closed contacts, and said cut-off relay having a coil adapted with said contacts to constitute a part of the initial energizing circuit of said line relay.

8. A telephone system comprising a subscriber's line, suitable sub-station apparatus, a spring jack, a relay, a battery for furnishing current to energize said relay, an operator's cord circuit provided with a plug adapted for insertion in said jack, a bridge adapted to be connected with opposite sides of said cord circuit, said bridge including a generator, suitable circuit connections, and an impedance coil connected between said bridge and ground, said impedance coil being adapted to insure an energizing circuit for said relay during the time the said generator is connected with the said circuit.

9. A telephone system comprising subscribers' lines, suitable sub-station apparatus for each line, a two-way spring jack connected with each line, a normally open switchpoint in one side of each line, a line relay and a cut-off relay for each line, line lamp signals adapted to be controlled by said line relays, each of said relays being provided with normally closed contacts, normally closed shunts around said normally open switch points, each shunt including normally closed contacts and coils of said relays, an operator's two-way cord circuit provided with plugs adapted for insertion in said jacks, a pair of relays bridged across one end of the cord circuit, a supervisory lamp adapted to be conjointly controlled by said pair of relays, another pair of relays bridged across the other end of the cord circuit, a second supervisory lamp adapted to be conjointly controlled by said second pair of relays, one relay of each pair being adapted to be controlled by one of said plugs and jacks, the other relay of each pair being adapted to be conjointly controlled by one of said plugs and jacks and means at a sub-station, and suitable circuit connections and means for supplying all necessary current.

10. In a telephone system, the combination of a subscriber's line relay, a subscriber's line, a normally open line circuit for initially energizing said relay, said relay being adapted to open said circuit as soon as energized, and a local energizing circuit for said relay adapted to be closed as soon as the same is energized.

11. In a telephone system, the combination with a telephone line, of a line relay therefor, a line signal, a cut-off relay for the line, said cut-off relay having a pair of con-

tacts normally in series with the line relay, said contacts being in series with the line relay and the line signal during the display of the signal, the actuation of the cut-off relay being adapted to open said contacts.

12. In a telephone system, the combination with a telephone line, of a line relay and a source of current normally bridged between the limbs of the telephone line at the central office, a line signal, the actuation of said line relay being adapted to sever said bridge and to place said line signal and said line relay in a local circuit with said source, and a cut-off relay adapted to be actuated to sever said local circuit and to replace said source in a bridge between the line conductors.

13. In a telephone system, the combination with a telephone line, of a source of current and a line relay normally bridged between the limbs of said line at the central office, a local energizing circuit for said line relay and a cut-off relay adapted, when actuated, to sever the local energizing circuit for said line relay.

14. In a telephone exchange system, the combination of a supervisory signal, a pair of relays conjointly controlling said signal, a local energizing circuit for one of said relays, a line signal, a second pair of relays conjointly controlling the said line signal, and local and line circuits each controlled by the relays of said second pair.

15. In a telephone exchange system, the combination of a supervisory signal, a pair of relays conjointly controlling said signal, a local energizing circuit for one of said relays, a line signal, a second pair of relays conjointly controlling the said line signal, local and line circuits each controlled by the relays of said second pair, and an energizing circuit common to a relay of each pair.

16. In a telephone exchange system, the combination of a supervisory signal, a pair of relays conjointly controlling said signal, a local energizing circuit for one of said relays, a line signal, a second pair of relays conjointly controlling the said line signal, local and line circuits each controlled by the relays of said second pair, and an energizing circuit common to a relay of each pair, said energizing circuit being local.

17. In a telephone exchange system, the combination of a supervisory signal, a pair of relays conjointly controlling said signal, a local energizing circuit for one of said relays, a line signal, a second pair of relays each controlling the said line signal, local and line circuits conjointly controlled by the relays of said second pair, an energizing circuit common to a relay of each pair, and a telephone line included in said energizing circuit.

18. In a telephone system, a subscriber's line, a line relay, a jack for said line, a cut-

off relay for opening the circuit of the line relay and closing a talking connection between the jack and the line, one side of the line being permanently connected with the jack, a cord circuit having a pair of supervisory relays bridged between the talking strands thereof, a supervisory signal controlled by said supervisory relays, and a local circuit for energizing the cut-off relay in series with one of said supervisory relays when the cord circuit is connected with the jack, the energizing of the cut off relay serving to disconnect the line relay from the line.

19. In a telephone system, a subscriber's line, a jack having a contact to which one side of the line is permanently connected, a line relay, a cut-off relay for deenergizing said line relay and closing a talking connection between the jack and the other side of the line, a cord circuit having a pair of supervisory relays bridged between the talking strands thereof, means for supplying current to the line for talking purposes, a supervisory signal controlled by said supervisory relays, and a circuit for energizing the cut-off relay in series with the jack and one of said supervisory relays, the energizing of the cut off relay serving to disconnect the line relay from the line.

20. In a telephone system, a subscriber's line, a jack provided with a contact permanently connected with one side of said line, a line relay, and a cut-off relay provided with means for deenergizing said line relay and closing a talking connection between the jack and the other side of said line, the energizing of the cut off relay serving to disconnect the line relay from the line.

21. In a telephone system, a subscriber's line, a jack having one contact thereof permanently connected with one side of the line, a line relay, a circuit for energizing the line relay, and a cut-off relay provided with means for simultaneously opening said circuit and establishing a talking connection between the jack and the other side of said line, the energizing of the cut off relay serving to disconnect the line relay from the line.

22. In a telephone system, a subscriber's line, a line relay, a source of current, said relay being normally connected between one side of the line and one pole of the source of current, a line circuit including the relay and source of current in series, a local circuit for said relay, and a cut-off relay provided with means for opening said circuit at a point between said line relay and the pole of the source of current to which it is normally connected.

23. In a telephone system, a subscriber's line, a line relay therefor, a source of talking and operating current, a line circuit including a line relay and source of current in series, a local circuit for said relay, a cord circuit, a cut-off relay, and means for energizing said cut-off relay over the talking strand of the cord circuit to open the said line circuit at a point between the line relay and the pole of the source of current to which the same is normally connected.

24. In a telephone system, a subscriber's line, a line relay therefor, a source of talking and operating current, a jack having one contact thereof permanently connected with one side of the line, an electromagnet, a line circuit including the line relay in series with the said source of current, means operated by said electromagnet for opening said circuit at a point between the line relay and the pole of said source of current to which it is normally connected, a local circuit for said relay, and means operated by said electromagnet for closing a talking connection between the jack and the other side of the line.

25. In a telephone system, a line, a relay controlling the continuity of said line and having a winding included in a normally closed battery bridge across said line at the exchange of central station.

Signed by me at Chicago, Cook county, Illinois, this 18th day of July, 1903.

HENRY P. CLAUSEN.

Witnesses:

A. F. DURAND,

WM. A. HARDERS.