H. P. CLAUSEN.

TELEPHONE SYSTEM.

APPLICATION FILED FEB. 21, 1902.

1,034,875.

Patented Aug. 6, 1912.

4 SHEETS—SHEET 1.

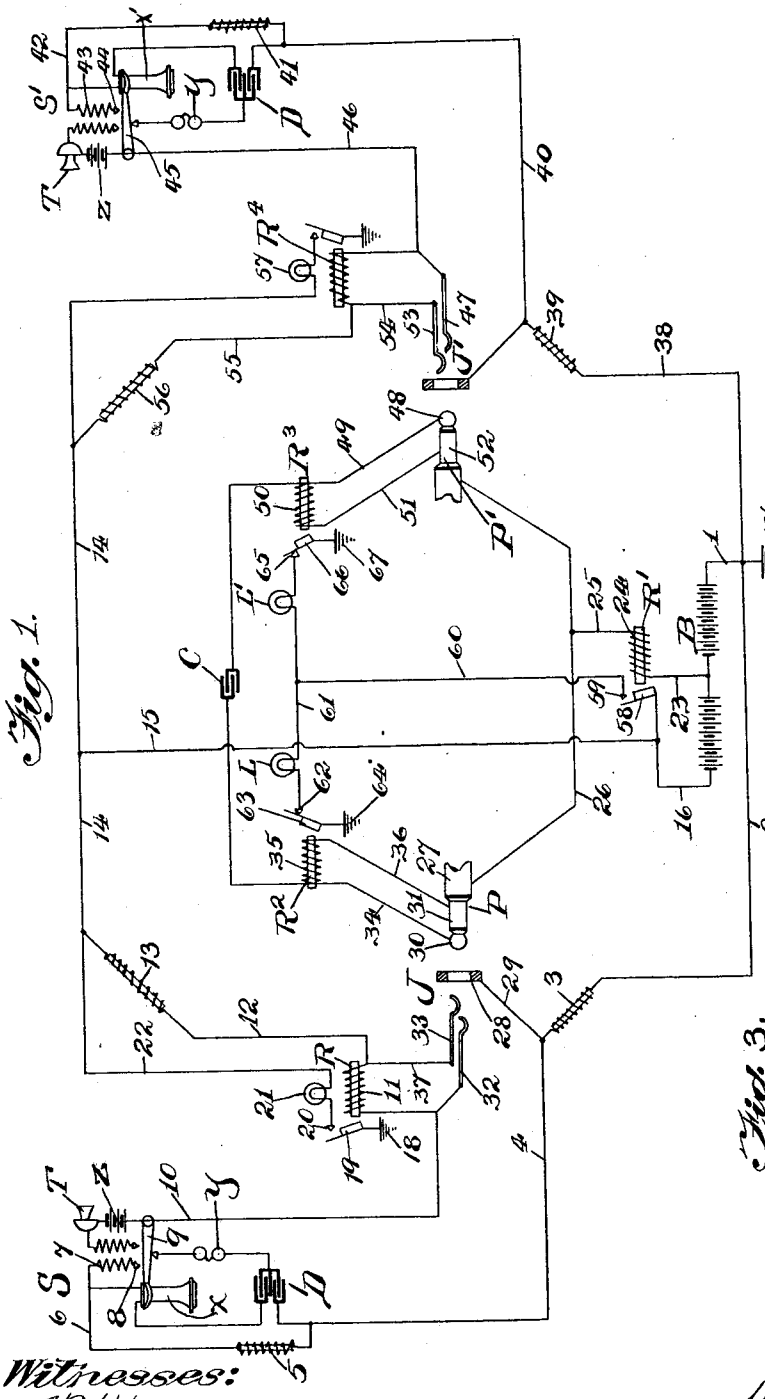

Fig. 1.

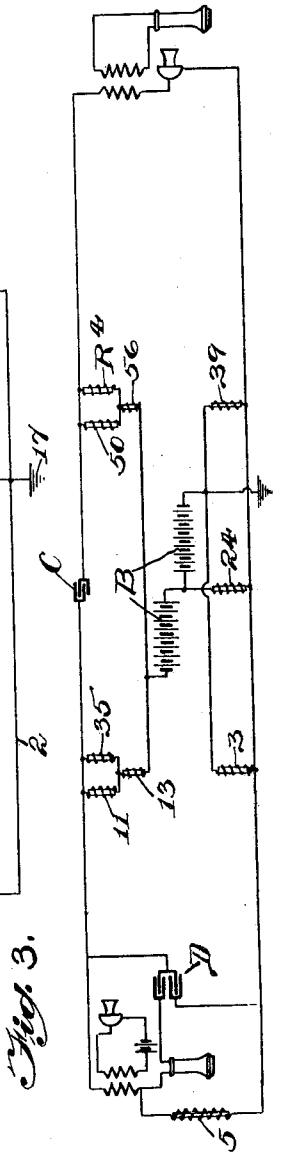

Fig. 3.

Witnesses:

J. B. Weir

Robert H. Otis.

Inventor:

Henry P. Clausen.

By Chas. C. Bulkley & Co.

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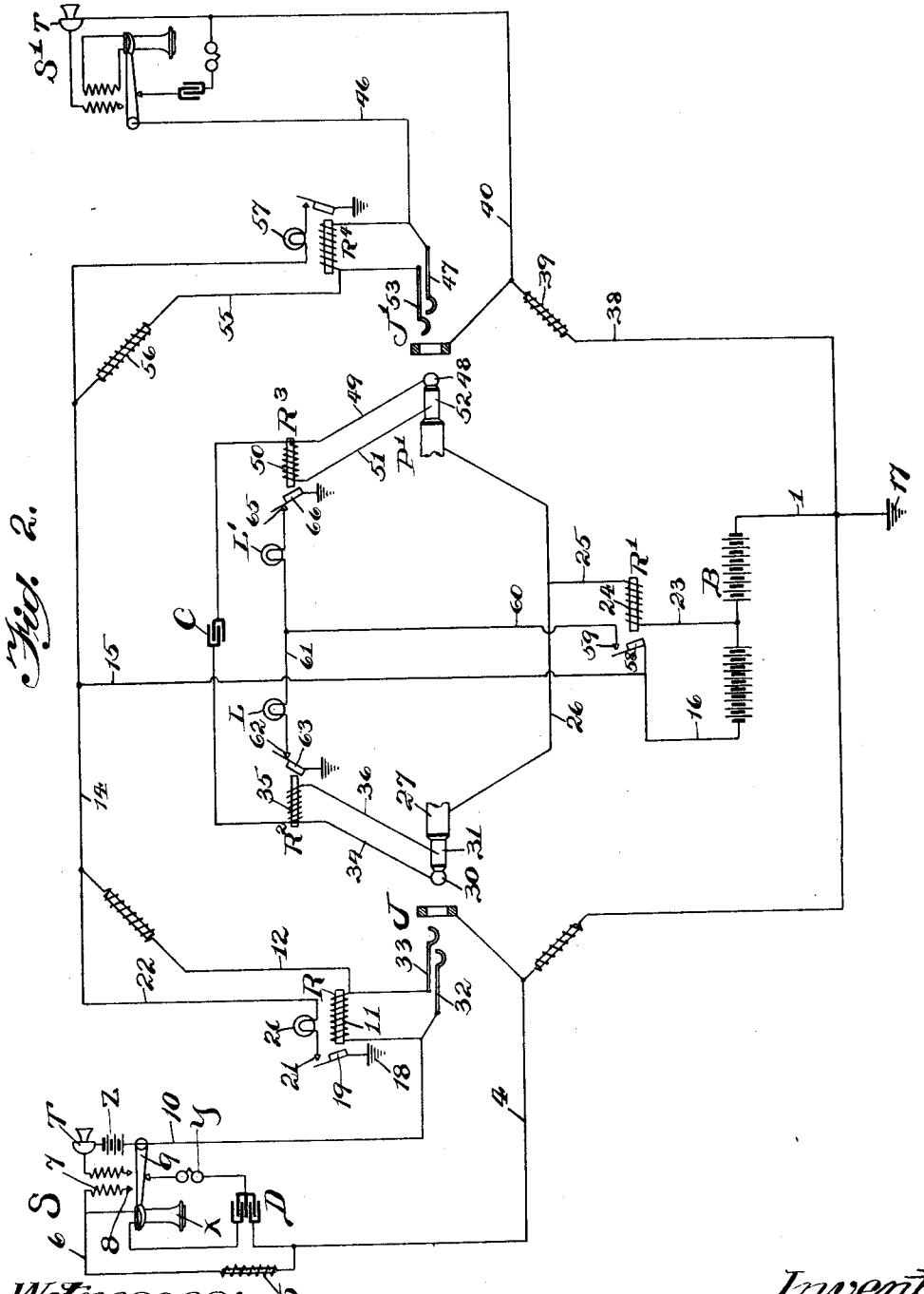
4 SHEETS—SHEET 2

Fig. 2.



Witnesses:

J. B. Weir

Robert H. Kerr

Inventor:

Henry P. Clausen,

By Chas. C. Burleigh, Atty.

H. P. CLAUSEN.

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4 SHEETS—SHEET 3.

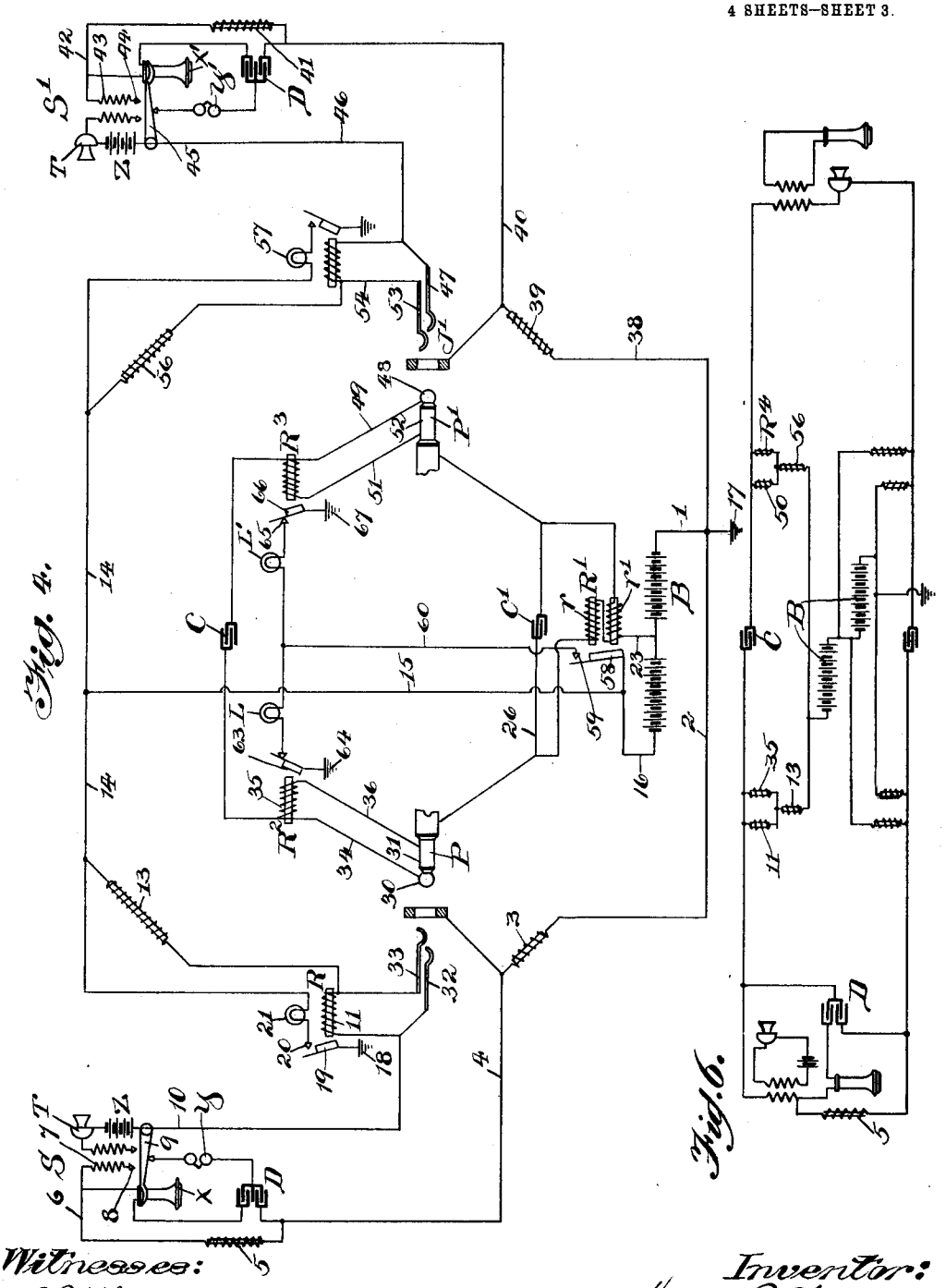

Fig. 4.

Fig. 6.

Witnesses:

J. B. Weir

Robert H. Stein

Inventor:

Henry P. Clausen,

By Chas. P. Buckley. Atty.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

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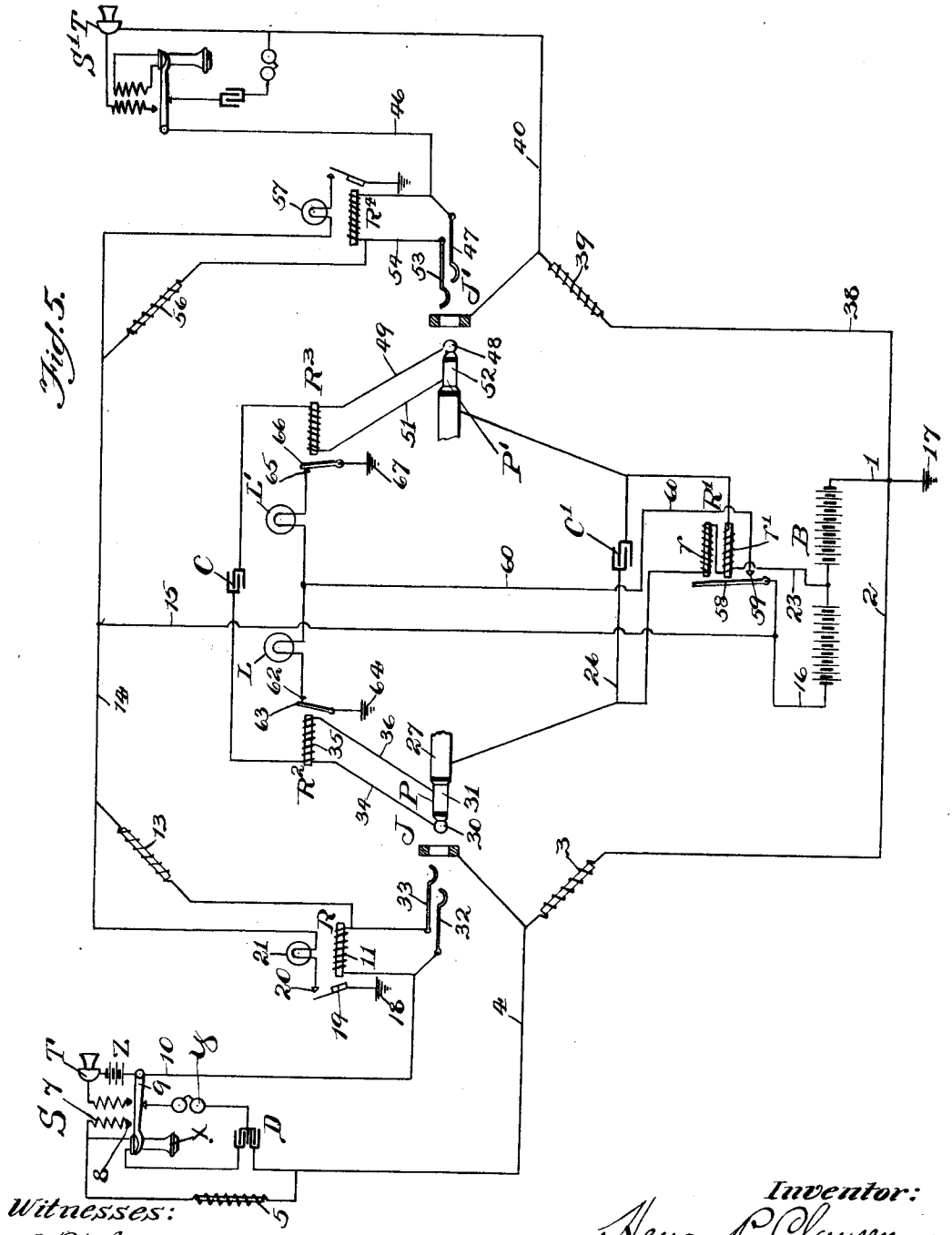
4 SHEETS—SHEET 4.

Fig. 5.



Witnesses:

J. B. Wes

Arthur F. Durand

Inventor:

Henry P. Clausen

By Chas. C. Burleigh.

Atty.

COLUMBIA PLANOGRAPH CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

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

TELEPHONE SYSTEM.

1,034,875. Specification of Letters Patent. **Patented Aug. 6, 1912.**

Application filed February 21, 1902. Serial No. 95,009.

To all whom it may concern:

Be it known that I, HENRY P. CLAUSEN, a citizen of the United States, and residing at Chicago, in the 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 in which complete metallic circuits are employed between the substations and the central exchange, and in which the current for operating certain signaling devices is supplied from a common battery located at the central station. In telephone systems of this character, the substations are connected with the central station by means of complete metallic circuits, rather than by grounded circuits, and the current for operating the various signals is supplied entirely from the central exchange. Signals, usually bells, are provided at the substations, whereby the central operator may call up the subscribers, and other signals, known as line signals, are provided at the central station, whereby the subscribers may call up the central operator. In addition to these, supervisory signals are also provided, whereby the central operator may know when the subscribers have hung up their receivers. Both the said line and supervisory signals usually consist of small incandescent lamps which are arranged on the switchboard in front of the central operator. The circuits for these lamps are controlled by relays, arranged to be either energized or deenergized by the manipulation of the hook-switches at the substations. The operator is usually provided with a cord circuit, with which the supervisory signals are associated, and which is provided with a pair of plugs adapted to be inserted in the jacks connected with the subscriber's lines. In this way, a subscriber may close a line circuit by removing a receiver from the hook at the substation, and the closed line circuit will operate the relay controlling the circuit of the line signal. The displaying of the line signal in this manner attracts the attention of the central operator, and the latter then inserts the answering plug of the cord-circuit in the jack allotted to the calling subscriber. After learning the number of the substation desired, the operator then inserts the other or calling plug of the cord-circuit in the jack of the line allotted to the called-for subscriber.

It is usually the practice to provide certain arrangements whereby the insertion of the plug in the jack of the calling subscriber will operate to extinguish the line signal. The supervisory signals are automatically operated and displayed when the subscribers hang up the receivers, and the central operator then withdraws the plugs of the cord-circuit from the two jacks. Ordinarily, the current, both for operating the relays and lighting the signal-lamps, and also for the transmitters at the substations, is supplied from a common battery located at the central exchange. It is desirable, however, at times to connect up a central exchange of this character with substations having local batteries—that is to say, with substations at which batteries are located for supplying current to the transmitters. In such case, the system is operated partly by current from the battery at the central exchange and partly by current from the batteries at the substations. Prior to my invention, more or less difficulty has been encountered in thus connecting up local battery substation apparatus with central exchange apparatus operating on the central energy principle.

It is, therefore, one of the principal objects of my invention to provide an improved circuit arrangement, whereby local battery substation apparatus may be connected up and made to operate satisfactorily with a central energy exchange. A special object is to provide an improved circuit arrangement, whereby connection of this character may be made without causing battery current to flow through the receivers at the substations.

It is also an object to provide certain details and features of improvement tending to increase the general efficiency and to render a telephone system of this character more serviceable and satisfactory in use.

To the foregoing and other useful ends,

my invention consists in matters hereinafter set forth and claimed.

In the accompanying drawings, Figure 1 is a diagram illustrating a telephone system involving the principles of my invention, and in which substations having local batteries are connected up with a central energy exchange. Fig. 2 is a view similar to Fig. 1, but showing only one substation having a local battery, and the other having a transmitter adapted to be supplied with current from the common battery at the central exchange. Fig. 3 is a simplified diagram showing the manner of supplying current to the lines with the circuit arrangement of the substation apparatus shown in Fig. 2. Fig. 4 is a diagram similar to Fig. 1, with the exception that in this view a condenser is shown in each strand of the cord circuit, and two coils are shown in the controlling relay for operating the supervisory signals. Fig. 5 is a diagram similar to Fig. 4, but showing the central exchange connected with substations of different character. Fig. 6 is a simplified diagram of the circuit arrangement shown in Fig. 5.

It will be readily understood that the instruments involved in the subscriber's or substation equipments at the different substations shown may be of any suitable, known or approved character consistent with their use in connection with either common battery or local battery transmission. Furthermore, it will be readily understood that the switchboard equipment at the central station can be of the usual type, generally speaking, there being spring-jacks, as illustrated, and hereinafter more fully described, at which the subscriber's lines terminate, and also operator's cords or cord-circuits provided with plugs adapted for insertion in these spring-jacks for the purpose of establishing connection between any two subscribers' lines. Also, it is obvious that the various relays, impedance coils and lamp signals can be of any suitable known or approved form or construction. The nature and construction of the telephone system and the purpose and functions of the various instruments and devices will, however, be best understood by describing the operation of the system as a whole.

Therefore, as illustrated and described, and referring to Figs. 1, 2 and 3, the operation of the system is as follows. Assuming that the subscriber at substation S desires connection with the subscriber at substation S′, as shown in Fig. 1, the subscriber at substation S first removes the receiver X from the hook-switch, and thereby completes a line circuit from the battery B, through conductors 1 and 2, through the impedance coil 3, through the line conductor 4, through the impedance coil 5, through conductor 6 and the secondary 7 of the induction coil, through the contact point 8 and the hook switch 9, through the line conductor 10 and the coil 11 of the line relay R, thence through the conductor 12 and the impedance coil 13, and through the conductors 14, 15 and 16 to said battery. This, it will be seen, energizes the line relay R and causes the latter to attract its armature. In this way, the line relay closes the short local circuit from the battery through the conductor 1 and the ground or common connections 17 and 18, through the relay armature 19, through the contact point 20, thence through the lamp 21 and the conductor 22, and through conductors 14, 15, and 16 to said battery. A current flowing through this local circuit lights the line signal lamp 21, and in this way the central operator is advised that a call has been sent in from the substation S. Acting on this signal, the central operator then inserts the answering plug P of the cord-circuit in the jack J, thereby establishing another local circuit from the battery B through conductor 23, through the coil 24 of supervisory relay R′, through the conductor 25 and the cord-strand 26, thence through the sleeve contact 27 of the said plug, through the ring or thimble contact 28 of the jack J, thence through the conductor 29 and the impedance coil 3, and through the conductors 2 and 1 to said battery. This energizes the supervisory relay R′ and causes the latter to attract its armature. It will also be seen that the insertion of the answering plug in this manner operates to shunt out the line relay R, by reason of the tip and ring contacts 30 and 31 of the plug making contact with the tip and ring contact springs 32 and 33 of the jack. The contacts of the plug and jack thus brought into contact allow current to pass from the line 10 through the tip spring 32 and the tip contact 30, thence through the cord-strand 34, through the coil 35 of the supervisory relay R^2, through the conductor 36 and the plug ring contact 31, and thence through the contact spring 33 of the jack, and the conductor 37. The coil of the relay R^2 is of lower resistance than the coil of the relay R, and consequently the supervisory relay R^2 and its connections constitute a shunt for shunting out and deënergizing the line relay R.

As stated, the insertion of the plug causes the current to energize the supervisory relay R′, thereby closing the normally open switch-point in the supervisory lamp circuit, but it will also be seen that at such time the energization of the relay R^2 operates to open one of the normally closed switch-points in the supervisory lamp circuit. Consequently the energization of the controlling relay R′

by the insertion of the plug does not cause the supervisory lamp L to light. At this point, the operator communicates with the calling subscriber in any suitable manner, as, for example, by employing the usual operator's talking set and listening key, and after learning the number of the substation desired, the operator then inserts the calling plug P′ in the jack J′. It will be observed that this jack J′ is connected with the line leading to the substation S′. It will also be observed, however, at this juncture, that the insertion of the calling plug P′ in the jack J′, and the consequent energization of the relay R′, has caused the supervisory lamp L′ to light, inasmuch as the supervisory relay R^3 is not energized. This lamp L′ remains lighted until the subscriber at substation S′ answers the call. When the subscriber at S′ removes the receiver X′ from the hook-switch, a line circuit is completed from the battery B, through the conductor 38, thence through the impedance coil 39, through the line conductor 40, through the impedance coil 41, through the conductor 42, through the secondary 43 of the induction coil, through contact point 44, through the hook-switch 45, thence through the line conductor 46, through the tip spring 47 of the jack J′, through the tip contact 48 of the plug, thence through conductor 51 and the ring contact 52 of the plug, through the ring contact spring 53 of the jack, through conductors 54 and 55, through the impedance coil 56, thence through conductors 14, 15 and 16 to said battery. The battery current flowing through this line circuit energizes the supervisory relay R^3, inasmuch as the latter is of lower resistance than the line relay R^4, and causes the said supervisory relay to attract its armature. This, it will be seen, breaks the local circuit through which the lamp L′ is lighted, thereby advising the central operator that the subscriber at substation S′ has answered the call. Also, as the said relay R^3 is of lower resistance than the relay R^4, the latter does not become energized by the closing of the line, and consequently the subscriber at substation S′ in answering the call does not cause the line lamp signal 57 to be displayed. With both receivers removed from the hook at the two substations, the subscribers are connected for talking purposes, the talking circuit, it being understood, consisting of the line conductors between the substations and the central exchange and the talking strands of the cord-circuit. Preferably, a condenser C is located in the strand of the cord-circuit, connecting the tips of the two plugs. In this way, the battery current is prevented from flowing through the said strand, and at the same time the latter is capable of serving as a conductor for voice currents.

When the subscriber at substation S hangs up the receiver X, the line circuit is broken, and the relay R^2 deënergized. This causes the latter's armature to close a short local circuit from the battery through the conductor 16, through the armature 58, through the contact-point 59, through the conductor 60, through the conductor 61, through the lamp L, through the contact point 62, through the armature 63, through the ground or common connections 64 and 17, and through the conductor 1 to said battery. This lights the supervisory lamp L and advises the central operator that the subscriber at substation S is through talking. In a similar manner, when the subscriber at substation S′ hangs up the receiver X′, the line circuit of the substation is broken, and the supervisory relay R^3 deënergized. The latter, in releasing its armature, causes the local circuit to be closed from the battery B, through the conductor 16, through the armature 58 and the contact-point 59, thence through the conductor 60, through the supervisory lamp L′, through contact-point 65, through the armature 66, thence through the ground or common connections 67 and 17, and through the conductor 1 to said battery. The current flowing through this local circuit lights the supervisory lamp L′, indicating, as in the previous case, that the subscriber at substation S′ has also hung up the receiver. The central operator then withdraws the plugs, and the system is then in its normal or disconnected condition, as shown in the drawings.

As previously stated, it will be understood that the operator's talking set can be of any suitable form or character, and can be connected with the cord circuit in the usual and well known manner. In this connection it will also be readily understood that the operator can be provided with the usual generator for ringing the bells y at the substations. These bells are bridged across the lines and arranged in series with the condensers D. It will be observed that these condensers are three-way in character, and that consequently each condenser is also in series with the associated receiver. Impedance coils 5 and 41 are in parallel with these condensers, and are also preferably in parallel with the receivers. With this arrangement, the talking circuits include the condensers, while the battery circuits include the impedance coils 5 and 41. In this way, the battery current does not flow through the receivers at the substations.

In Fig. 1 both substations are provided with local batteries Z for supplying current to the transmitters T. Each transmitter is provided with a local circuit including a local battery, and also including the primary of the induction coil and the hook-

switch. When the hook switches are down, as shown in the drawings, both the line and the local circuits are open, and the bells are in circuit with the lines through the condensers, which latter permit generator ringing current to pass, but which prevent the passage of battery current. When the hook switches are up, the receivers are connected in the lines through the condensers, which latter also permit the passage of voice currents. In this way, the central energy exchange can be connected up with local battery substations, and connections of this character can be made without causing battery current to flow through the substation receivers. The three-way condensers simplify the arrangement by obviating the necessity of encumbering the subscribers' sets with a number of condensers. It will also be seen that the line and supervisory signals are operated in a simple and efficient manner, and that the system, although simple and involving comparatively few circuits and devices, is nevertheless characterized by substantially all of the approved methods of operation. It will be readily understood that the resistance of the various resistance coils and relays can be adjusted or regulated by those skilled in the art, and in accordance with the conditions of any particular case.

In Fig. 2, the circuit arrangement is substantially the same as shown in Fig. 3, with the exception that the apparatus at substation S′ does not include a local battery, and in this case, therefore, the exchange is connected up with a local battery substation, and also with a substation having such apparatus as is usually employed in connection with central energy systems. Thus it will be seen that with my improved circuit arrangement, a central energy exchange can be connected up with both local battery and common battery substations.

In Figs. 4, 5, and 6, the substation apparatus is substantially the same as shown in the preceding figures, it being observed that in Fig. 4 the central exchange is connected up with two local battery substations, while in Figs. 5 and 6 the exchange is connected up with one local battery station and one common battery station. In said Figs. 4, 5, and 6, it will be seen, however, that the cord-circuit involves a second condenser C′, in addition to the condenser C of the previous diagrams, and, furthermore, that the relay R′ is provided with two coils instead of one. The two coils r and r' of this double-coil relay are interposed between the battery and the lower strand of the cord-circuit, one coil being connected at one side of the condenser C′, and the other coil being connected at the other side. With this arrangement, the insertion of the plug P will energize the coil r, while the insertion of the plug P′ will energize the coil r', consequently the insertion of either plug will close the controlling supervisory relay R′, thereby closing the normally open switch-point in the supervisory lamp circuits. The insertion of either plug, therefore, as is also the case with the arrangement shown in Fig. 1, places the supervisory lamp circuits in readiness to be closed by the de-energization of the supervisory relays R^2 and R^3. With the circuit arrangement shown, it will be seen that the battery is connected directly to the line, rather than through the medium of the cord circuit. In Figs. 3 and 6, the relative arrangement of the coils is shown through which the current is supplied to the lines. As stated, the three-way condensers not only prevent the flow of battery current through the receivers at the substations, but also prevent the continuous operation of the line signals.

What I claim as my invention is—

1. A telephone system comprising a substation and a central station and suitable line connection between the same, a line signal at the central station, a source of current at the central station for operating said line signal, a local battery and a transmitter in a normally open local circuit at the substation, a receiver and a condenser connected in series in the line at the substation, a hook-switch for said receiver, a bell connected between said condenser and the contact-point upon which said hook-switch normally rests, and an impedance coil arranged in parallel with said receiver and condenser.

2. A telephone system comprising a subscriber's line, a jack connected with the line at the central station, a source of current permanently connected with the line, a cord-circuit having a plug adapted for insertion in said jack, a line lamp signal having a normally open local circuit including said source of current supply, a line relay for controlling said normally open local circuit, a condenser and a receiver in the line at the substation, a hook-switch for said receiver, a local battery and a transmitter included in a normally open local circuit at the substation, and an impedance coil arranged in parallel with said receiver and condenser.

3. In a telephone system, a subscriber's line, a transmitter and a receiver at the subscriber's station, a three-way condenser included in the line circuit and also in a bridge across the line, and a hook-switch for said receiver adapted to form part of said bridge when the receiver is in place.

4. In a telephone system, a subscriber's substation, apparatus, comprising a receiver and a transmitter, a hook-switch for said receiver, a bell and a three-way condenser, said condenser, bell and hook-switch constituting

a bridge across the line, said condenser being also connected in series with the receiver, a local battery, an induction coil having its primary located in a local circuit including said battery and transmitter, the secondary of said induction coil being in series with the receiver when the latter is off said hook-switch, and an impedance coil arranged in parallel with said receiver and condenser.

5. In a telephone system, a line circuit, a bridge across the line circuit and a three-way condenser forming part of the line-circuit and also part of the bridge across the line-circuit, an operator's cord circuit, two supervisory relays, a local circuit, a central station, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over said local circuit completed when a cord-connection is established to line, and whereby the other supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his receiving telephone.

6. In a telephone system, a line circuit, a bridge across the circuit having a normally closed switchpoint, a three-way condenser forming a part of the line circuit, and also part of said bridge, and an impedance coil connected in parallel with the condenser, the circuit in which the impedance coil is located being normally open.

7. In a telephone system, a subscriber's line connecting a substation with a central station, a line relay at the central station, a battery at the central station permanently connected with the line, a circuit-changing device and an impedance coil at the substation for closing the line at the latter point and thereby energizing said relay, a condenser arranged in parallel with said impedance coil, and a receiver arranged in series with said condenser and in parallel with said impedance coil, the parallel connection in which the impedance coil is located being adapted to permit the passage of battery current when the line is closed by the said circuit-changing device, an operator's cord circuit, two supervisory relays, a local circuit, a central station, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over said local circuit completed when a cord-connection is established to line, and whereby the other supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his receiving telephone.

8. A telephone system comprising a substation and a central station and suitable line connection between the same, a line relay at the central station, a source of current at the central station permanently connected with the line, a circuit-changing device at the substation, a bridge having a switch-point normally closed by said circuit-changing device, a condenser located in the line and also forming a part of said bridge, a bell in said bridge, and an impedance coil arranged in parallel with the condenser and receiver and forming a part of the line circuit when the latter is closed by said circuit-changing device.

9. A telephone system comprising a pair of subscribers' lines, a central exchange at which said lines terminate, a relay in each line, a central source of current supply connected with the lines, a transmitter at one of said substations adapted and arranged to be supplied with current from said central source of current supply, an induction coil having its primary arranged in series with said transmitter, a receiver connected with both terminals of the secondary of said induction coil, a transmitter and a local battery included in a normally open circuit at the other substation, said local battery circuit also including the primary of an induction coil, a condenser and a receiver connected in series in the line at the substation having said local battery, and an impedance coil arranged in parallel with said receiver and condenser when the line is closed.

10. In a telephone system, a subscriber's substation apparatus provided with a three-way condenser forming inductive talking and ringing connection in said apparatus, an operator's cord circuit, two supervisory relays, a local circuit, a central station, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over said local circuit completed when a cord-connection is established to line, and whereby the other supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his receiving telephone.

11. In a telephone system, the combination of substations and a central station and suitable line connection between the same, a two-way cord-circuit, a condenser in one strand of said cord-circuit, supervisory relays connected with the cord strand provided with said condenser, supervisory lamps each having a local circuit provided with two switch-points, one normally open and the other normally closed, the normally closed switch-points being controlled by said supervisory relays, a central source of current supply for operating said lamps and relays and for supplying current to the lines, a third supervisory relay for controlling the normally open switch-point in the circuits of said supervisory lamps, line lamp signals having normally open circuits including said source of current supply, line relays for con-

trolling the local circuits of said line lamps, transmitters and local batteries included in normally open local circuits at the substations, condensers in the lines at the substations, receivers connected in series with said condensers, and impedance coils arranged in parallel with said receivers and condensers and forming a part of the line circuits when the lines are closed.

12. In a telephone system, the combination of a substation and a central station and suitable line connection between the same, a central source of current supply connected with the lines, a two-way cord-circuit, a condenser in a strand of the cord-circuit, supervisory relays connected with one strand of the cord-circuit, supervisory lamps, local circuits for said lamps having normally closed switch-points controlled by said relays, a third relay having two coils connected between said source of current supply and the other strand of said cord circuit, said third relay being arranged to control a normally open switch-point in the circuits of said supervisory lamps, a transmitter at one substation connected and arranged to be supplied with current from said central source of current supply, a transmitter and local battery included in a normally open local circuit at the other substation, a receiver and a condenser in series and located at the substation having the local battery, and an impedance coil arranged in parallel with said condenser and receiver and adapted to form part of the line circuit when the line is closed.

13. In a telephone system, the combination of subscribers' lines, a line relay in each line, line lamp signals controlled by said line relays, a central station, a central source of current supply connected with the lines and included in the local circuits of said line lamps, an operator's cord circuit, supervisory lamps associated with said cord circuit, three supervisory relays for controlling normally closed and normally open switch-points in the circuits of said supervisory lamps, condensers and receivers connected in series at the substation and impedance coils arranged in parallel with said condensers and receivers and adapted to form part of the battery circuits when the lines are closed, said condensers forming part of the talking circuits when the lines are closed, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over said local circuit completed when a cord connection is established to line, and whereby another supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his telephone.

14. In a telephone system, a subscriber's telephone equipment including a condenser having more than two terminals connected with said equipment, an operator's cord circuit, two supervisory relays, a local circuit, a central station, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over said local circuit completed when a cord-connection is established to line, and whereby the other supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his receiving telephone.

15. In a telephone system, a condenser having more than two terminals, conductors leading from said terminals, an operator's cord circuit, two supervisory relays, a local circuit, a central station, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over said local circuit completed when a cord-connection is established to line, and whereby the other supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his receiving telephone, a receiver in which one conductor terminates, a bell or ringer in which another conductor terminates, and an impedance coil in which a third conductor terminates.

16. A telephone system comprising three-way condensers at the substations, line relays at the central station and supervisory relays adapted to be placed in parallel with said line relays at the central station when connection is established between any two lines, an operator's cord circuit, a central station, suitable means and connections whereby one supervisory relay in the operator's cord circuit is energized over a local circuit completed when a cord-connection is established to line, and whereby the other supervisory relay in such cord circuit is energized over the line circuit opened when the subscriber on the connected line hangs up his receiving telephone.

17. In a telephone system, a telephone line, a line relay permanently connected therewith, a supervisory relay in parallel with said line relay, and a battery permanently connected with the line at a point between said relays and feeding current through the same in parallel to the line for talking purposes, said supervisory relay normally entirely disconnected from said battery.

18. In a telephone system, a telephone line, a line relay permanently connected therewith, a supervisory relay in parallel with said line relay, and a battery having both poles permanently connected respectively with opposite sides of the line and feeding current through the relays in parallel to one side of the line for talking pur-

poses, said supervisory relay normally entirely disconnected from said battery.

19. In a telephone system, a line, a divided battery permanently connected therewith, a supervisory relay permanently connected with the middle point of said battery, a line relay and signal for said line, and another supervisory relay forming a shunt for deënergizing the line relay of said line to retire the line signal thereof.

Signed by me at Chicago, Cook county, Illinois, this 11th day of February, 1902.

HENRY P. CLAUSEN.

Witnesses:

ARTHUR F. DURAND,

HARRY P. BAUMGARTNER.