H. P. CLAUSEN.

TELEPHONE SYSTEM.

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1,044,747.

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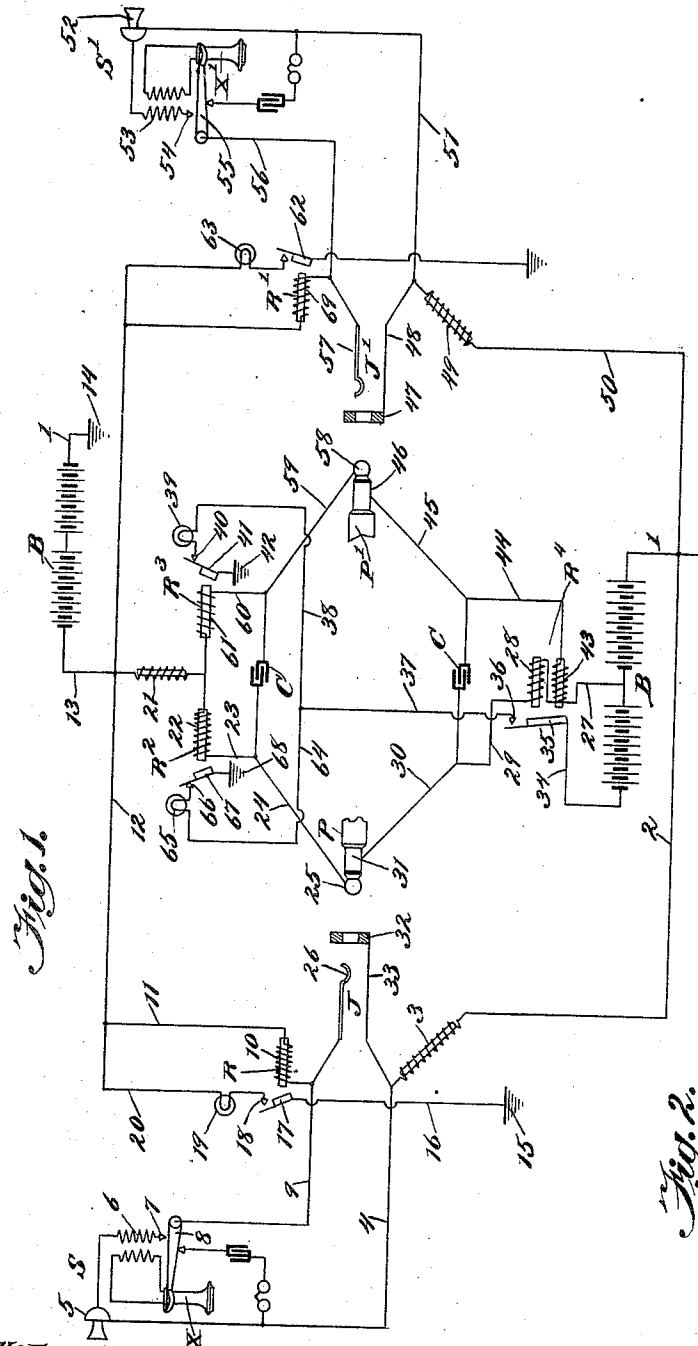

Fig. 1.

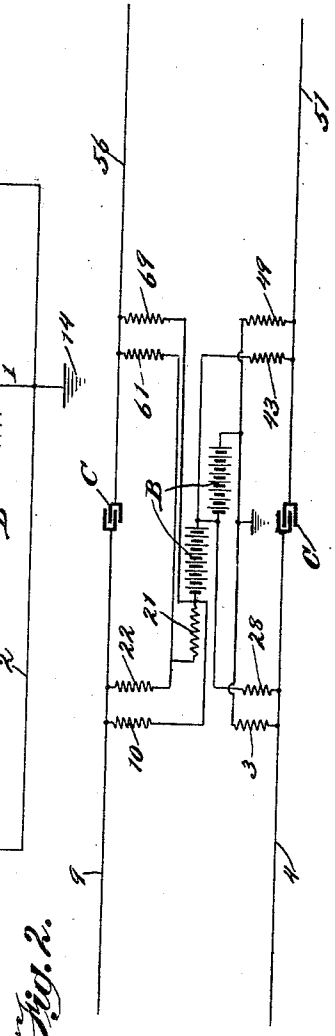

Fig. 2.

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TELEPHONE SYSTEM.

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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, residing at 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 in general, and more particularly to systems of the complete metallic circuit and central energy type. In telephone systems of this character, it is usually the practice to employ complete metallic circuits between the substations and the central exchange, so as to avoid the use of grounded circuits. The central operator at the exchange is usually provided with a cord circuit, which serves as a means for establishing connection between the lines of any two subscribers. This cord-circuit is provided with plugs adapted for insertion in jacks connected with the lines. Signaling devices are also provided, whereby the subscribers may call up the central operator, and also whereby the subscribers may signal for a disconnection when they have finished their conversation. These signals are, therefore, of two classes, to-wit, line or calling signals, and supervisory or clearing-out signals. The line or calling signals are usually connected with the lines, and are arranged to be brought into action by the removal of the receiver from the hook at the substations. The supervisory signals are associated with the cord-circuit, and are also arranged to be brought into action by the manipulation of the hook-switches at the substations. In a system of this kind, the current, both for talking and signaling purposes, is supplied from a common battery located at the central exchange. The said line and supervisory signals usually consist of small incandescent lamps arranged in position to be easily observed by the central operator. The local circuits for these lamps are preferably controlled by relays. Both the relays and the lamps are supplied with current from the common battery. It is also the practice to provide suitable circuit arrangements whereby a line or calling signal may be automatically extinguished or restored by the insertion of one of the cord plugs in the jack allotted to the line of the calling subscriber.

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

A special object is to provide an improved circuit arrangement for operating the line and supervisory signals.

Another object is to provide an improved circuit arrangement for supplying the current to the lines.

It is also an object to provide certain details and features tending to increase the general efficiency, and to render a system of this character less expensive to install and maintain, and to simplify the general construction, while retaining substantially all of the advantages and approved methods of operation which characterize more complicated systems.

The nature and operation of my invention, together with other advantages, will, however, hereinafter more fully appear.

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

In the accompanying drawings, Figure 1 is a diagram illustrating a telephone system embodying the principles of my invention, it being observed that only two substations, together with a cord-circuit and suitable connections, are shown, and it being understood that only such instruments and apparatus are illustrated as are necessary to enable those skilled in the art to have a full understanding of the invention. Fig. 2 is a simplified diagram of the circuit arrangement shown in Fig. 1, but merely illustrating the manner in which the current is supplied to the talking circuit after the lines are connected up by the insertion of the plugs.

As thus illustrated, it will be seen that the system comprises subscriber's telephone sets of any suitable character at the substations S and S′. Also, with the arrangement shown, the subscriber's lines terminate in the usual spring-jacks J and J′. The line relays R and R′, of any suitable known or approved construction, are connected with the lines at the central station and adapted to control line lamp signals in the well understood manner. The switchboard apparatus at the central station also, of course, includes an operator's cord circuit consisting of parallel talking strands terminating in the tip and sleeve contacts of plugs P and P′ adapt-

ed for insertion in the jacks. Supervisory relays R^2, R^3 and R^4 are connected with the cord circuit and adapted to jointly control the usual supervisory lamps.

It will be seen that the centralized source of current B is permanently connected with the lines through the impedance coils 3, 21 and 49, and through the line relays. Furthermore, it will be observed that during the conversation there is a central source of current and a plurality of supervisory relays in bridge across the cord circuit, and consequently across the talking circuit. In this way, current is supplied to the line directly and also through the supervisory coils of the cord circuit apparatus.

It will be understood that the usual operator's talking set can be of any suitable or desired construction. Also, the usual generator can be employed at the central station for ringing the bells at the substations.

As thus constructed, and assuming that the subscriber at substation S desires connection with the substation S′, the operations and circuit connections which take place are as follows: When the receiver X at substation S is removed from the hook, a circuit is then completed from the central or common battery B, through conductors 1 and 2, to the impedance coil 3, thence through the line conductor 4, through the transmitter 5, through the primary 6 of the induction coil, through the contact point 7 and the switch-hook 8, thence through the other line conductor 9, through the coil 10 of relay R, and thence through conductors 11, 12, and 13, to said battery. The current flowing through the line circuit thus closed energizes the relay R and causes the latter to attract its armature. The operation of the line relay R in this manner completes a local circuit from the battery through the connections 1, 14, 15 and 16, through the armature 17, and the contact point 18, through the line lamp signal 19, and thence through conductors 20, 12, and 13, to said battery. The flow of current through this local circuit lights the lamp 19, indicating to the central operator that the subscriber at substation S has sent in a call. The central operator then inserts the plug P of the cord-circuit, in the jack J, so as to establish communication with the calling subscriber. The insertion of this plug in the jack allotted to the calling subscriber's line completes a line circuit from the battery through the conductor 23, through the talking strand 24 of the cord-circuit, through the plug-tip 25, through the tip spring 26 of the jack, thence through line conductor 9, through the switch-hook 8, and the contact point 7, through the transmitter 6 of the induction coil, through the transmitter 5, through the line conductor 4, through impedance coil 3, and thence through conductors 2 and 1 to said battery. The completion of this line circuit which includes a part of the cord-circuit, operates to shunt out the relay R, inasmuch as the relay R^2 is of comparatively low resistance. It will be seen that the shunt for shunting out the line relay R consists of the impedance coil 21, the coil 22, the conductors 23 and 24, and the tip contacts 25 and 26. As stated, this shunt is of relatively low resistance, and consequently the insertion of the plug deënergizes the relay R. When deenergized the relay R releases its armature, thereby opening the local circuit through the lamp 19. Thus the operator in answering a call automatically extinguishes the line lamp signal 19. It will also be observed that the insertion of the plug in the jack J serves to complete a circuit from the middle point of the battery B through conductor 27, through the coil 28 of supervisory relay R^4, through the conductor 29, through the talking strand 30 of the cord-circuit, thence through the sleeve contact 31 of the plug and the ring or thimble 32 of the jack, through the conductor 33, thence through impedance coil 3, and then through the conductors 2 and 1 to said battery. The current flowing through this local circuit, which includes one side of the line and one side of the cord-circuit, energizes the relay R^4 and causes the latter to attract its armature. The armature of the relay R^4, in closing, completes a local circuit from the battery B through conductor 34, thence through the said armature 35 and the associated contact-point 36, thence through conductors 37 and 38, through supervisory lamp 39, through contact-point 40 and armature 41, and thence through the ground or common connections 42 and 14 to said battery. In this way, the insertion of the plug in the jack of the calling subscriber automatically lights the supervisory lamp allotted to the other end of the cord-circuit. As will be seen, this supervisory lamp 39 remains lighted until the subscriber at substation S′ has answered the call. At this juncture it will be understood that the operator communicates with the calling subscriber, so as to ascertain the number of the substation desired, and it will also be understood that the operator's talking set, whereby communication is had with the calling subscriber, may be of any suitable form or character.

Upon learning the number of the substation desired, which, as stated, is assumed to be the substation S′, the central operator then inserts the plug P′ in the jack J′. This jack J′ is, it will be observed, similar to the jack J, and is connected with the line of the called-for subscriber. The insertion of the plug P′ in the jack J′ serves to complete a circuit from the battery through conductor 27, through the coil 43 of the supervisory relay R^4, thence through conductor 44,

through the talking strand 45 of the cord-circuit, through the sleeve contact 46 of the plug, thence through the ring or thimble contact 47 of the jack, through the conductor 48, thence through impedance coil 49, and through the conductors 50 and 1, to said battery. This energizes the other coil 43 of the supervisory relay R^4, which relay, it will be observed, has been previously energized and closed by the insertion of the plug P in the jack J. In this way, the insertion of either plug in a jack will close the supervisory relay R^4, which is the controlling relay of the supervisory apparatus. After inserting the plug P′ in the jack J′, it will be understood that the operator then signals the subscriber at substation S′. This signaling can be accomplished in any suitable manner, as, for example, by employing the usual generator for ringing the bell at said substation. When the subscriber at substation S′ answers the call by removing the receiver X′ from its hook or switch, a line circuit is completed from the battery through conductors 1 and 50, through the impedance coil 49, through the line conductor 51, through transmitter 52, through the primary 53 of the induction coil, thence through the contact-point 54 and the switch-hook 55, through the other line conductor 56, and through the tip spring 57 of the jack, thence through the tip contact 58 of the plug, through the talking strand 59 of the cord-circuit, through conductor 60, thence through the coil 61 of the supervisory relay R^3, through the impedance coil 21, and thence through conductor 13 to said battery. The flow of current through this line circuit energizes the supervisory relay R^3, thereby causing the latter to attract its armature. In thus attracting its armature the relay R^3 opens the local circuit in which the supervisory lamp 39 is located, and in this way the called-for subscriber in answering a call automatically extinguishes the supervisory lamp 39, thereby advising the central operator that the call has been answered. It will also be seen that the completion of this line circuit shunts out the coil 69 of the line relay R′, this relay being also of comparatively high resistance, while the relay R^3, like the relay R^2, is of comparatively low resistance. It will be seen, therefore, that the relay R′ is shunted out by a shunt connection consisting of the impedance coil 21, coil 61, the conductor 60, the cord-circuit 59, and the tip contacts 58 and 57. Hence the called-for subscriber in answering a call also automatically shunts out the line relay of substation S′, and thereby prevents the armature 62 from closing the local circuit through line lamp signal 63. It will be understood, however, that the lamp 63 will light when the subscriber at substation S′ sends in a call, in a manner similar to the way in which lamp 19 is lighted by the sending in of a call from substation S.

When the subscriber at substation S hangs up the receiver X, the shifting of the hook-switch serves to break the line circuit, and to, in this way, deënergize the supervisory relay R^2, and in this way the said relay R^2 releases its armature and allows the latter to fall back and close a local circuit from the battery through the conductor 34, through the armature 35 and the contact-point 36, thence through conductors 37 and 64, through the supervisory lamp 65, through the contact-point 66 and the armature 67, and thence through the ground or common connections 68 and 14, back to said battery. The flow of current through this local circuit lights the lamp 65, thereby indicating to the central operator that the subscriber at substation S has finished talking. In a similar manner, when the subscriber at substation S′ hangs up the receiver X′, the line circuit is broken, the supervisory relay R^3 deënergized, and a local circuit completed through the lamp 39, in the manner already described. In this way, each subscriber automatically signals for disconnection, and the central operator, upon observing these signals, withdraws the plugs from the jacks. The system, as far as the two substations are concerned, is then in its normal or disconnected condition, as shown in Fig. 1 of the drawing.

It will be readily understood that the talking circuit from one substation to the other includes the line connections and also the talking strands of the cord-circuit. It will be observed that a condenser C is preferably located in each talking strand of the cord-circuit, and that, in this way, the latter is practically divided into two parts, the strands of which are inductively continuous, as far as voice currents are concerned, but which are conductively discontinuous with respect to the battery current. With the arrangement shown, the relays R^2 and R^3 are connected in parallel with the condenser on that side of the cord circuit, while the coils 28 and 43 of the relay R^4 are connected in parallel with the other condenser. In this way, and with the provision of the impedance coil 21, there is no danger of transmission of voice currents through the relays R^2 and R^3. The arrangement insures an efficient operation of the relays and signals, and also an economic distribution of current. The impedance coil 21 is found to have a particularly efficient action with respect to voice transmission and current supply.

Fig. 2 of the drawings illustrates, in a simplified manner, the connections existing between the batteries or centralized source of current during conversation—that is to say, during the time the lines are connected

up by the cord circuit. From this it will be seen that the different coils, and also the source of current are in bridge across the talking circuit, and that current is fed to the line at points each side of the condensers.

Thus it will be seen that the system, although simple, and involving comparatively few circuits and devices, has substantially all of the advantages of more complicated systems, and is characterized by substantially all of the approved methods of operation. With the improved circuit arrangement for shunting out the line relays, no objectionable sounds are produced in the receivers at the substations, and in this way the circuit arrangement tends to quiet the lines and to enable the central operator to answer calls without annoying the subscribers. Furthermore, the arrangement affords an advantageous and economical use of two supervisory signals, and of a suitable number of relays in connection with a two-way cord-circuit. It will also be seen, by referring to Fig. 2, that the arrangement insures an economical and even distribution of current to the subscribers' lines. It will be understood that the resistance of the various relays and resistance coils can be readily regulated or adjusted or varied by those skilled in the art, and in accordance with the conditions and desired results.

What I claim as my invention is—

1. In a telephone system, the combination of substations and a central station and suitable line connection between the same, jacks and a cord-circuit having plugs adapted for insertion in said jacks, a central source of current supply connected with the lines, line relays connected with the lines, local circuits including said source of current supply and having normally open switch-points controlled by said line relays, line lamp signals located in said local circuits, circuit-changing devices at the substations for closing the line circuits and thereby energizing said line relays, so as to light the line signal lamps, supervisory relays normally connected with the source of current and the cord circuit, supervisory signals controlled by said supervisory relays, suitable connections whereby each supervisory relay, together with a portion of the cord-circuit and registering contacts of a plug and jack, combine to form a shunt around one of said line relays, the supervisory relays being of lower resistance than the line relays, whereby the line relays are shunted out and deenergized when the plugs are inserted in the jacks, and a third supervisory relay connected between the cord-circuit and said source of current supply and arranged to control the said supervisory signals.

2. In a telephone system, the combination of substations and a central station and suitable line connections between the same, a central source of current supply connected with the lines, jacks and an operator's cord-circuit for establishing connection between the lines, line relays controlling line signals, circuit-changing devices at the substations for operating said line relays, supervisory lamps associated with the cord-circuit, the local circuit of each supervisory lamp having two switch-points, one normally closed and the other normally open, relays normally connected with the source of current for controlling said switch-points, suitable connections between said relays and said source of current supply, the relays which control the said normally closed switch-points being of lower resistance than the line relays, whereby when the plugs are inserted in the jacks the current is shunted through the said low resistance supervisory relays, so as to cut out or deenergize the line relays and restore the line signals.

3. In a telephone system, the combination of a line relay, a relatively low resistance supervisory relay and suitable connections for shunting out said line relay, a source of current, and an impedance coil interposed between said source of current and said supervisory relay, there being a cord circuit with a condenser in each talking strand, and the source of current and supervisory relay being bridged in series across the cord circuit at one side of said condensers.

4. In a telephone system, the combination of a line relay, a line signal lamp having a normally open local circuit controlled by said line relay, a source of current supply for energizing the relay and lighting the lamp, a supervisory relay of relatively low resistance, a supervisory lamp having a local circuit controlled by said supervisory relay, connections whereby the supervisory relay is energized and the supervisory lamp lighted by current from said source of current supply, and an impedance coil interposed between said supervisory relay and said source of current supply, the said impedance coil and the said supervisory relay combining to form a shunt for shunting or deënergizing the line relay, there being a cord circuit with a condenser in each talking strand, and the source of current and supervisory relay being bridged in series across the cord circuit at one side of said condensers.

5. In a telephone system, the combination of substations and a central station and suitable line connection between the same, a source of current connected with the line, line relays connected between the lines and the source of current, circuit-changing devices at the substations for closing the line circuits and thereby energizing said line re-

lays, said signals controlled by said line relays, jacks and a cord-circuit for establishing connection between the lines, a condenser in each talking strand of the cord-circuit, supervisory relays connected in parallel with each condenser, supervisory lamps associated with the cord-circuit, each supervisory lamp having a local circuit provided with two switch-points, one normally closed and the other normally open, the supervisory relays which control the normally closed switch-point being of relatively lower resistance than the line relays, suitable connections whereby the supervisory relays are energized and the supervisory lamps are lighted by current from said source of current supply, and connections whereby the said relatively low resistance supervisory relays operate to shunt out and deënergize the line relays when the plugs are inserted in the jacks.

6. In a telephone system, the combination of substations and a central station and suitable line connection between the same, a source of current supply connected with the lines, line relays connected between the lines and source of current supply, circuit-changing devices at the substations for closing the line circuits and thereby energizing the line relays, line signals controlled by said line relays, jacks and a two-way cord-circuit for establishing connection between the lines, a condenser in the talking strand of the cord-circuit, supervisory relays connected in parallel with each condenser, supervisory lamps associated with the cord-circuit, each supervisory lamp having a local circuit provided with two switch-points, one normally closed and the other normally open, the relays which control the said normally closed switch-points, being of lower resistance than the said line relays, an impedance coil interposed between the source of current supply and the said relatively low resistance supervisory relays, suitable connections whereby the supervisory lamps are lighted and the supervisory relays energized by current from said source of current supply, and suitable connections whereby the said impedance coils and the said relatively low resistance relays combine to form shunts for shunting out and deënergizing the line relays when the plugs are inserted in the jacks.

7. In a telephone system, the combination of line lamps, line relays for closing the circuits of said line lamps, supervisory lamps provided with circuits having normally closed and normally open switch points, supervisory relays of lower resistance than the line relays, and normally connected with a source of current for controlling normally closed switch-points in the circuits of said supervisory lamps, circuit connections whereby each relatively low resistance supervisory relay forms part of a shunt for shunting out and deënergizing the line relay, another relay for controlling the normally open switch-point in the circuit of each supervisory lamp, and a source of current suitably connected for energizing said relays and lighting said lamps.

8. The combination with a telephone line, of a line signaling electro-magnet and a battery both permanently connected in series in the line, a supervisory relay of lower resistance than the said electro-magnet and adapted to be connected in parallel therewith when a connection is established with the line, said supervisory relay normally connected with said battery, a supervisory signal having its circuit normally closed through said relay, and a switch in the said circuit closed when the connection is established and opened when the connection is taken down, whereby the signal is inert before connection is made with the line and active when connection is made and the subscriber replaces his telephone upon the hook.

9. The combination with a telephone line, of a line relay, a battery and a resistance in series in the line; a supervisory relay of comparatively low resistance adapted to be connected in parallel relation with said line relay when a conversational circuit is established with the line, said supervisory relay normally connected with said battery, whereby the substation transmitter is charged by current from the said battery flowing through the resistance coil and the supervisory relay, the said coil and supervisory relay possessing sufficient impedance to prevent the passage of voice currents, a supervisory signal having its circuit controlled by said relay when the line is switched for use so as to render the signal inert during conversation, and means for normally rendering said signal inert.

10. The combination of a pair of metallic telephone lines; of a line signaling device of high resistance, a battery and a resistance in series in each line in the order named; a cord circuit having a pair of strands adapted to connect with the lines beyond the said device and resistance, a condenser interposed in the strand connecting the signaling device limbs together, a supervisory relay of low resistance associated with each end of the cord circuit and connected with the strand containing the condenser, upon the opposite sides thereof, said supervisory relay normally connected with the same pole of the battery as the limb containing the signaling device, a supervisory signal for each end of the cord circuit, the current through which signal is controlled by the corresponding relay when the lines are united for conversation, so as to render the signal inert during conversation, said lamp circuits being normally open, and means for

automatically closing the same in establishing the connection.

11. In a telephone system, a two-wire line circuit and a two-conductor cord circuit, a line relay permanently connected with a limb of the line circuit, a relay for the cord circuit adapted to be placed in parallel with the line relay when the cord is connected with the line and of lower resistance than the line relay, whereby the current in the line will be sufficient for actuating the cord relay, but insufficient for the actuation of the line relay, a second relay for the cord circuit, and a signal circuit conjointly controlled by the two cord relays, substantially as described.

12. A common battery telephone system comprising two subscribers' lines connected for conversational purposes through the medium of a pair of condensers, one in each side of the circuit, a divided battery having one pole connected with one side of the circuit at points each side of one of said condensers, and having its grounded pole connected with the other side of the circuit at points each side of the other condenser, the middle point of said battery being also connected with the last-mentioned side of the circuit at points on each side of said last-mentioned condenser.

13. A common battery telephone system comprising subscribers' lines connected for conversational purposes, a battery bridged across the talking circuit, temporarily shunted line relays, the shunts around said line relays constituting part of the connection between the battery and one side of the talking circuit, supervisory relays also constituting a part of the said connection between the battery and one side of the talking circuit, impedance coils also constituting part of said connection, and additional supervisory relay coils and impedance coils comprised in the connection between the other pole of the battery and the other side of the talking circuit.

14. In a telephone system, a line, a divided battery permanently bridged on the line, and a cord permanently connected with the middle part of said battery, with condensers in the talking circuit.

15. In a telephone system, a line, a divided battery permanently bridged across said line, and a cord circuit across which a portion of said battery is permanently bridged at a plurality of points, with condensers interposed between the bridges.

16. In a telephone system, a cord circuit, a double-wound relay having a winding associated with each plug of said cord, and an answering supervisory signal and a calling supervisory signal having their circuits completed by the actuation of said relay.

17. In a telephone system, a cord circuit condensers in each side of said cord circuit, a double-wound relay having a winding connected to the cord-circuit on one side of one of said condensers, and another winding connected on the other side, and a plurality of supervisory signals controlled by said relay.

18. In a telephone system, subscribers' lines, a cord circuit adapted to be connected therewith, a relay having a winding adapted to be energized when the answering plug is connected with a subscriber's line, and another winding for said relay adapted to be energized when the calling plug is connected with a line, and a plurality of supervisory signals controlled by said relay.

19. In a telephone system, subscribers' lines, a cord circuit associated therewith, a divided battery bridged across said lines and a double-wound relay connected to the middle point of said battery, and an answering and calling supervisory signal controlled thereby.

20. In a telephone system, subscribers' lines, a cord circuit associated therewith, a divided battery for supplying talking and signaling current for said lines, a double-wound relay connected to the middle point of said battery, one winding of said relay associated with the answering plug of said cord and the other winding associated with the calling plug, and answering and calling supervisory signals controlled by said relay.

21. In a telephone system, subscribers' lines, a cord circuit associated therewith, a divided battery bridged across said line for supplying talking and signaling current thereto, a condenser in said cord-circuit and a double-wound supervisory relay connected to the intermediate point of said battery and having one winding connected to the cord-circuit on one side of said condenser and another winding connected on the other side, and plurality of supervisory signals controlled by said relay.

Signed by me at Chicago, Cook county, Illinois, this 31st day of January, 1902.

HENRY P. CLAUSEN.

Witnesses:
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HARRY P. BAUMGARTNER.