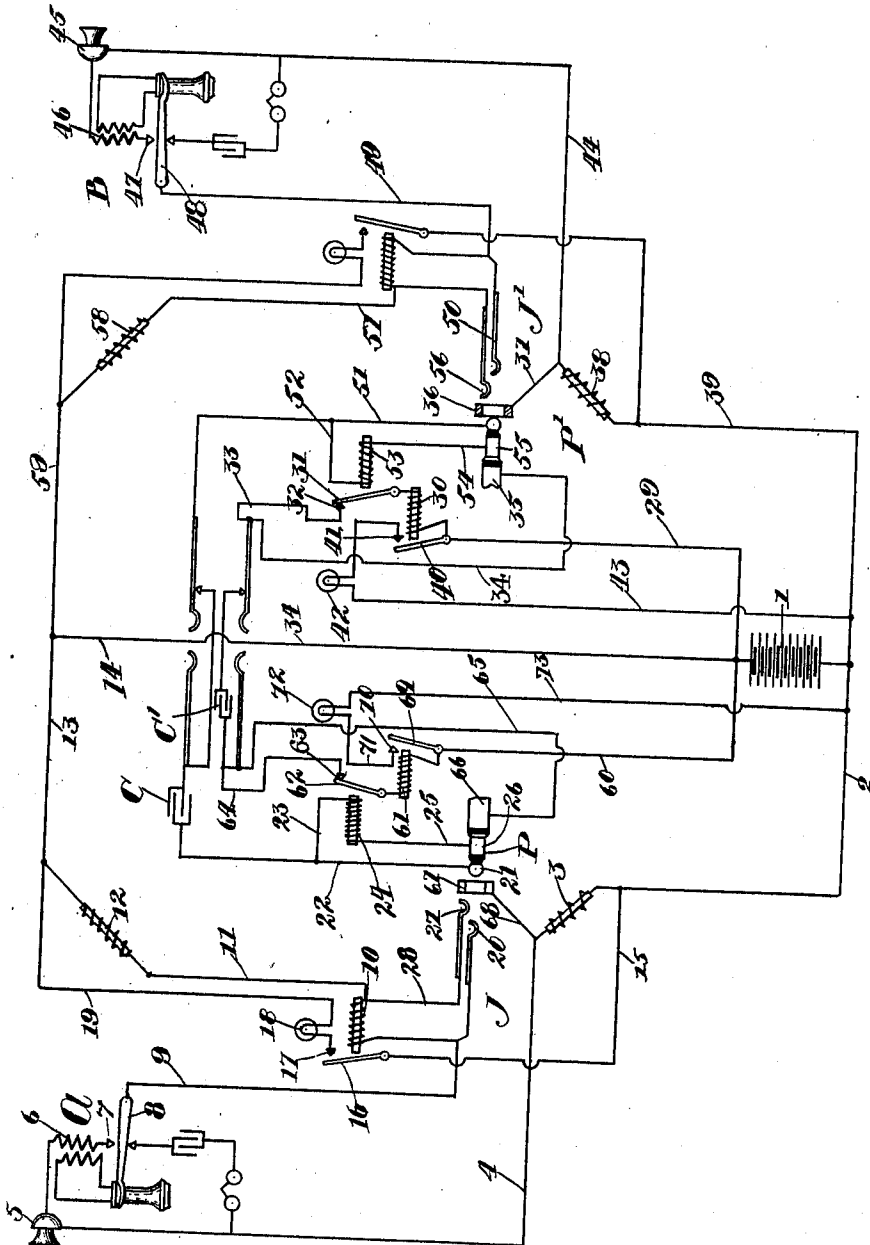


H. P. CLAUSEN.
TELEPHONE SYSTEM.
APPLICATION FILED MAR. 17, 1902.

992,165.

Patented May 16, 1911.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

992,165.

Specification of Letters Patent.

Patented May 16, 1911.

Application filed March 17, 1902. Serial No. 98,462.

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 in which complete metallic circuits are employed between the substation and the central exchange, and in which the current, both for talking and signaling purposes, is supplied from a battery or other suitable source at the central station. In systems of this character a line signal, preferably in the nature of a small incandescent lamp, is usually associated with each line, and the circuit connections are such that each line signal glows or responds to a call sent over the line to which it is allotted. It is also the practice to provide each line with one or more spring jacks and to employ, as a means for establishing connection between any two lines, a flexible cord provided at each end with a plug adapted for insertion in one of said jacks. With this arrangement, a subscriber can signal the central operator and the latter, after inserting the answering plug of the cord-circuit in the jack of the calling subscriber, so as to receive the order for connection, can then establish the desired connection by inserting the calling plug of the cord-circuit in the jack of the called subscriber. In addition to the foregoing, it is usual to associate one or more supervisory or clearing-out signals with the cord-circuit, so as to enable the central operator to know when the subscribers have finished talking and hung up their receivers. Like the line signals, these supervisory signals preferably consist of small incandescent lamps, which are connected and arranged to light up or glow as soon as their local circuits are caused to close by the opening of the line circuits. As previously stated, the current, both for the microphone transmitters at the substations and the line and supervisory signals at the central exchange, is furnished from a common battery located at the central station. It is also the practice to provide suitable circuit connections whereby the insertion of the answering plug

of the cord-circuit will operate to automatically extinguish or restore the line signal.

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

A special object is to provide an improved circuit arrangement which will obviate the necessity of supplying battery current to the line through the cord-circuit, and to, in fact, avoid as much as possible the passage of battery current for any and all purposes through the strands of the cord-circuit, so as to insure against a burning out of the cords, and particularly so as to leave the cord-circuit free of battery current during conversation between two subscribers.

In other words, it is a particular object of my invention to provide an improved arrangement whereby no battery current is furnished directly from the battery through the cord-circuit during conversation, and, furthermore, to thus avoid the use of relays in the cord strands.

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 reliable in use.

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 telephone system embodying the principles of my invention. In this diagram only two substations are shown, together with two subscribers' lines and an operator's cord-circuit. It will be understood that only such instruments and devices are illustrated as are necessary to a full understanding of the operation of the invention.

It will be readily understood that the subscriber's equipment or substation apparatus, at the substations A and B can be of any suitable known or approved character, consistent with the principles and mode of operation of a common-battery or centralized-source-of-current telephone system. At the central station, the switchboard apparatus comprises an operator's cord-circuit pro-

vided with plugs P and P¹, which latter are adapted for insertion in the spring-jacks J and J¹, these jacks being respectively connected with the lines leading from substations A and B. The battery 1, or other suitable centralized source of current, is, it will be seen, permanently connected with the lines, and adapted to supply current for both talking and signaling purposes.

Obviously, the various relays, lamp signals, condensers, impedance coils, etc., shown in the drawings and hereinafter described, can be of any suitable, known or approved character. The nature and functions of the various devices and instruments, and also the character, purpose and advantages of the different circuit arrangements will, however, be best understood by describing the operation of the system as a whole; and as illustrated and described, and assuming that the subscriber at substation A desires connection with substation B, the operation of a telephone system characterized by my invention is as follows: Upon the removal of the receiver from the subscriber's hook-switch at substation A, a complete metallic circuit is completed from the battery 1 through the battery lead 2 and the impedance coils 3, thence through the line conductor 4 to the subscriber's transmitter 5, thence through the primary 6 of the induction coil, through the contact point 7 and the hook-switch 8, thence through the other line conductor 9, through the line relay 10, thence through conductor 11 and impedance coil 12, and through conductors 13 and 14 and back to said battery. The current flowing through this closed line circuit energizes the relay 10, causing the latter to attract its armature. When attracted, the said armature completes a local circuit from the battery 1, through the conductors 2 and 15, through the said armature 16 and its contact point 17, thence through the line lamp 18 and the conductor 19, and through the conductors 13 and 14 to said battery. The current flowing through this closed local circuit causes said lamp to light up or glow, and to thereby advise the central operator of the call. Upon observing this signal, the central operator then inserts the answering plug P in the jack J, it being observed that the latter is connected with the calling subscriber's line. This, it will be seen, operates first to shunt out the line relay 10, the current flowing from the line through the tip spring 20 of the jack, through the tip 21 of the plug, through the conductors 22 and 23, through the supervisory relay 24, through the conductor 25, through the ring contact 26 of the plug, through the ring contact spring 27 of the jack, and thence through the conductor 28 to the conductor 11, rather than from the line through the said relay 10. This, it will be understood, is

for the reason that the relay 24 is of less resistance than the line relay. The shunting out of the line relay in this way operates to automatically break the local circuit of the line lamp 18. Thus the operator in inserting the answering plug in the calling subscriber's jack automatically extinguishes or restores the line signal. In addition to the foregoing, it will also be seen that the insertion of the answering plug in this manner serves to energize the relay 24 by reason of the latter being included in the line circuit, and to thus prevent the operation of the supervisory signal. In other words, the insertion of the answering plug practically places the supervisory signal apparatus in condition to respond or operate when the line circuit is broken by the hanging up of the receiver at the substation.

It will be readily understood that the central operator can employ any of the usual or well known means for communicating with the different subscribers. Upon receiving the order for connection from the calling subscriber at substation A, the operator then inserts the calling plug P' in the jack J'. This jack is connected with the line leading to substation B. After inserting the calling plug, the operator then presses the usual ringing-key; so as to ring the subscriber's bell at substation B. The insertion of the calling plug in the jack J' serves to complete the short local circuit from the battery 1 through conductor 29, thence through the coil of supervisory relay 30, through the armature 31, through the contact-point 32, thence through the conductors 33 and 34, through the sleeve contacts 35 and 36 of the plug and jack, through the conductor 37 and the impedance coil 38, and thence through the conductor 39 to said battery. The current flowing through this local circuit energizes the supervisory relay 30, causing the latter to attract its armature. The said armature when attracted closes a second local circuit from the said battery through conductor 29, through the armature 40, through the contact-point 41, thence through the supervisory lamp 42, and through the conductor 43 to the battery. The current flowing through this second local circuit causes the lamp 42 to light up or glow. This lamp continues to glow until the subscriber at substation B answers the call. When the call is answered, the line circuit is completed from the battery 1, through the conductor 39 and impedance coil 38, through the line conductor 44 to the subscriber's transmitter 45, thence through the primary 46 of the induction coil, through the contact-point 47 and the hook-switch 48, thence through the other line conductor 49, through the tip spring 50 of the jack, through the cord-strand 51 of the cord-circuit, through the conductor 52 and the coil of the super-

visory relay 53, through the conductor 54, through the ring contacts 55 and 56 of the plug and jack, thence through conductor 57 and the impedance coil 58 and through the conductors 59 and 14 to said battery. This, it will be seen, energizes the relay 53, causing the latter to attract its armature. The said armature when attracted breaks the local circuit including the relay 30, causing the latter to release its armature. The armature 40, when released, opens the circuit of the supervisory lamp 42. In this way, as stated, the called subscriber in answering the call automatically extinguishes or restores the supervisory lamp 42. The central operator then understands that the called subscriber has answered the call. It will be understood that the line relay allotted to the line of the called subscriber is of higher resistance than the supervisory relay 53. Hence the latter is, as stated, included in the line circuit of substation B. With both line circuits thus closed the two subscribers are connected up for conversation, it being understood that the talking circuit includes the parallel line conductors, the tip and sleeve contacts of the jackets and plugs, and also the two parallel talking strands of the cord-circuit. The condensers C and C' are preferably interposed in the talking strands of the cord-circuit. In this way, the cord-circuit is divided into two inductively connected halves or parts. During conversation it will be seen that the battery current is supplied directly to the lines through permanent connections therewith, and that no battery current passes through the cord-circuit strands, except what current is necessary to energize the relays 24 and 53. It will be seen, however, that this current energizing the two supervisory relays, is supplied from the lines, and not directly from the battery through the cord-circuit. In other words, during conversation there is only a small amount of line current flowing through the cord-circuit, the relays 24 and 53 being practically located in line shunts and not, strictly speaking, in shunts through the cord-circuit. Both terminals of each shunt are in the line.

When the subscribers have finished talking and have hung up their receivers, the operations and circuit connections are as follows: The hanging up of the receiver at substation A opens up the line circuit, and interrupts the flow of current through the supervisory relay 24. This supervisory relay when thus deenergized, releases its armature and the latter closes the short local circuit from the battery 1, through conductor 60, through the relay 61, through the armature 62, through the contact point 63, thence through conductor 64, through the conductor 65, through the sleeve contacts 66 and 67 of the plug and jack, thence through the conductor 68 and impedance coil 3, and through the battery lead 2 to said battery. This energizes the relay 61, causing the latter to attract its armature. The said armature when attracted closes a second short local circuit, from the battery 1, through the conductor 60, through the armature 69, through the contact-point 70, through the conductor 71 and the supervisory lamp 72, thence through the conductors 73 and 2 to said battery. The second glowing of the lamp 72 advises the central operator that the subscriber at substation A has finished talking and hung up the receiver. In a similar manner the hanging up of the receiver at substation B causes the deenergizing of the relay 53, and a consequent closing of the local circuit including the lamp 42. The circuits through the supervisory relay 30 and the said lamp 42 have been previously described. Upon receiving these clearing-out signals, the central operator then withdraws the plugs from the jacks and the system is then in its normal or disconnected condition. Thus, as stated, during conversation there is only a slight amount of line current passing through the cord-circuit, and no current supply through the cord-circuit directly from the battery. At the same time the circuit arrangement is such as to permit the employment of the usual clearing-out signals, so as to give the central operator complete supervision of the connections. Furthermore, the advantage of shunting out the line relays is obtained without the disadvantage of supplying battery current to the lines through the cord-circuit. In other words, the circuit arrangement has the advantage of shunting out the line relays in answering calls, so as to extinguish the line signals, but without the necessity of thereby creating a double source of current to one side of the line. It often happens in systems of this character that one of the cord-strands becomes partially broken or injured in such manner as to, when included in a battery circuit, cause more or less arcing. This sparking or arcing of the current across the break of the cord-circuit is very objectionable, as it is sure to burn out the cord. With my improved arrangement, however, it will be seen that the liability of injuring the cord-circuit is greatly reduced. During conversation, as explained, there is only a small amount of line current flowing through small portions of the cord-circuit. The local circuits for the supervisory relays 61 and 30 include portions of the talking strands, but these circuits, it will be seen, are broken immediately after they are closed and while the subscribers are talking, and consequently the flow of current is of such short duration as not to be objectionable. It will be readily understood that the resistance of the various resistance coils and relays can

be suitably regulated or adjusted by those skilled in the art, and in accordance with the conditions of any particular case.

The various advantages of my improved circuit arrangement will be readily apparent to those skilled in the art.

I claim as my invention—

1. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line circuit, a three-way jack connected with the line, a line relay for operating a line signal, said relay being connected with the tip and ring contact springs of said jack, a central source of current supply connected with the line, an operator's cord-circuit provided with a three-way plug adapted for insertion in said jack, a supervisory relay of lower resistance than the line relay and connected with the tip and ring contacts of the plug, a supervisory relay associated with the cord-circuit and arranged to be energized when the first mentioned supervisory relay is deenergized by the opening of the line-circuit, and a supervisory lamp included in an open circuit having a normally open switch-point which remains open until closed by said second supervisory relay.

2. In a telephone system, the combination of a subscriber's line, a line relay for operating a line signal, a three-way jack connected with the line, an operator's cord-circuit provided with a three-way plug adapted for insertion in said jack, a supervisory relay connected with the tip and ring contacts of said plug, said supervisory relay being of less resistance than the line relay, so as to shunt out the latter when the plug is inserted in the jack, a supplemental supervisory relay connected and arranged to be energized when the said supervisory relay is deenergized, and a supervisory lamp included in a local circuit having a normally open switch-point which remains open until closed by said supplemental supervisory relay.

3. A telephone system comprising a subscriber's line, a subscriber's hook-switch for opening and closing the line, a three-way jack connected with the line, a line relay connected with the tip and ring contact springs of said jack, a battery permanently connected with the line at the central exchange, an operator's cord-circuit provided with a three-way plug adapted for insertion in said jack, a supervisory relay connected with the tip and ring contacts of said plug and arranged to be deenergized when the line circuit is broken by said switch, a supplemental relay associated with the cord-circuit and arranged to be energized when the said supervisory relay is deenergized, the local circuit of said supplemental relay including the sleeve contacts of the jack and plug, and a supervisory lamp included in a

local circuit having a normally open switch-point which remains open until closed by said supplemental relay.

4. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line circuit, a battery connected with the line at the central exchange, a line relay for operating a line signal, a jack connected with the line and having two contacts which are connected with the terminals of said line relay, an operator's cord-circuit provided with a plug adapted for insertion in said jack, a supervisory relay having its terminals connected with two contacts of said plug, the said supervisory relay being of less resistance than the line relay, so as to shunt out the latter when the plug is inserted in the jack, a supplemental relay associated with the cord-circuit and arranged to be energized when the supervisory relay is deenergized by the opening of the line circuit by said switch and a supervisory lamp, the local circuit of said lamp including a normally open switch-point which remains open until the supervisory relay is deenergized and the supplemental relay energized.

5. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line circuit, a battery at the central exchange permanently connected with the line, a jack permanently connected with the line at the central exchange, an operator's cord-circuit provided with a plug adapted for insertion in said jack, a supervisory relay having its terminals connected with two contacts of said plug, a supplemental relay arranged to be energized when the supervisory relay is deenergized by the opening of the line-circuit by said switch, the local circuit of said supplemental relay including one talking strand of the cord-circuit, and a supervisory lamp included in a local cord-circuit having a normally open switch-point controlled by said supplemental relay, said normally open switch-point remaining open until closed by the deenergizing of the supervisory relay and the consequent deenergization of the supplemental relay.

6. In a telephone system, the combination of a subscriber's line, a subscriber's hook-switch for opening and closing the line circuit, a three-way jack connected with the line, a battery connected with the line, a line relay having its terminals connected with the tip and ring contact springs of said jack, a line lamp included in a local circuit having a normally open switch-point controlled by said line relay, an operator's cord-circuit provided with a three-way plug adapted for insertion in said jack, a supervisory relay connected with the tip and ring contacts of said plug, suitable impedance coils through which current is furnished from the battery

to the line, a supplemental relay arranged to be energized when the supervisory relay is deenergized by the opening of the line circuit by said switch, the local circuit of said supplemental relay including the sleeve contacts of the plug and jack, a condenser in each talking strand of the cord-circuit, and a supervisory lamp included in a local circuit having a normally open switch-point controlled by said supplemental relay, said normally open switch-point remaining open until closed by the deenergizing of the supervisory relay and the energizing of the supplemental relay.

7. In a telephone system, the combination of a subscriber's line, a subscriber's switch or circuit-changing device for opening and closing the line circuit, a jack connected with the line, a line relay for operating a line signal, an operator's cord-circuit provided with a plug adapted for insertion in the jack, a battery at the central station connected with the line, line impedance coils through which current is furnished from the battery directly to the line, and a relay normally connected to a talking strand and supervisory lamp associated therewith, said lamp being included in a local circuit controlled only by said relay, a supervisory electromagnetic device connected and arranged to be controlled by said switch or circuit changing device and adapted to control the circuit of said relay, said local circuit remaining open until closed by the opening of the line-circuit and the consequent energizing of the relay.

8. In a telephone system, the combination of a subscriber's line, a subscriber's switch for closing the line-circuit, a line relay for operating a line signal, a jack connected with the line, an operator's cord-circuit provided with a plug adapted for insertion in said jack, a central source of current connected with the line, line impedance devices through which current is furnished from the said source directly to said line, a normally open line shunt for shunting said line relay when the plug is inserted in the jack, and a relay normally connected to a talking strand and a supervisory lamp associated therewith, the local circuit of said lamp being controlled only by said relay, and a supervisory electromagnetic device connected and arranged to be controlled by said switch and adapted to control the circuit of said relay, said local circuit remaining open until closed by the opening of the line circuit and the consequent energizing of the relay.

9. In a telephone switch-board, the combination of line relays, supervisory relays, plugs and jacks and suitable connections for placing the supervisory relays in parallel with the line relays, to retire the line signals, supplemental relays having local circuits provided with normally closed switch

points controlled by the supervisory relays and normally open switch points controlled by the said plugs and jacks, and supervisory lamps having local circuits provided with normally open switch points controlled only by said supplemental relays.

10. In a telephone system, the combination of subscriber's lines, line relays, a battery connected with the line through said relays, impedance coils in series with the line relays, line lamps in parallel with said relays and impedance coils, said lamps having local circuits provided with normally open switch points controlled by said relays, supervisory relays connected and arranged to be placed in parallel with said line relays, supplemental relays having local circuits controlled by said supervisory relays, and supervisory lamps having local circuits controlled by said supplemental relays.

11. In a telephone system, an operator's cord circuit, a pair of supervisory relays for each end of said cord circuit, one member of each pair excluded from the talking circuit and controlling the other, and a supervisory lamp controlled exclusively by the other said member of each pair, together with means under the control of the operator for producing an audible call signal at the called subscriber's station over a complete metallic ringing circuit.

12. In a telephone switch-board, the combination of line relays, supervisory relays adapted to be placed in parallel with said line relays, supplemental relays having local circuits controlled directly by said supervisory relays, and supervisory lamps having local circuits controlled exclusively by said supplemental relays, together with a common battery or centralized source of current supply permanently connected with both sides of the lines to furnish the electric current necessary for talking and signaling purposes, said supplemental relays provided with armatures adapted when attracted to close the circuit of the lamps.

13. In a telephone system, the combination of line relays, a cord circuit, supervisory relays connected with the cord circuit and adapted to be placed in parallel with the line relays, a common battery or centralized source of current supply permanently connected with both sides of the lines to furnish the electric current necessary for talking and signaling purposes, and supplemental relays directly controlled by said supervisory relays, provided with armatures adapted when attracted to close the circuits of the lamps, said lamp circuits having no other points of control.

14. In a telephone system, the combination of a subscriber's line, a line relay for operating a line signal, a three-way jack connected with the line, an operator's cord-circuit provided with a three-way plug

adapted for insertion in said jack, a supervisory relay connected with the tip and ring contacts of said plug, said supervisory relay adapted to shunt out the latter when the
5 plug is inserted in the jack, a supplemental supervisory relay connected and arranged to be energized when the said supervisory relay is deenergized, and a supervisory lamp included in a local circuit having a nor-
10 mally open switch-point which remains open until closed by said supplemental supervisory relay.

15 15. In a telephone system, a line relay, and a low-wound supervisory relay for shunting the line relay, said line relay perma-

nently connected with the central battery, said supervisory relay normally entirely disconnected from the battery.

16. In a telephone system, a pair of supervisory relays, a supervisory signal controlled by said relays, and a line relay
20 adapted to be shunted by one of said supervisory relays to retire the line signal.

Signed by me at Chicago, Cook county, Illinois this 14th day of March 1902.

HENRY P. CLAUSEN.

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