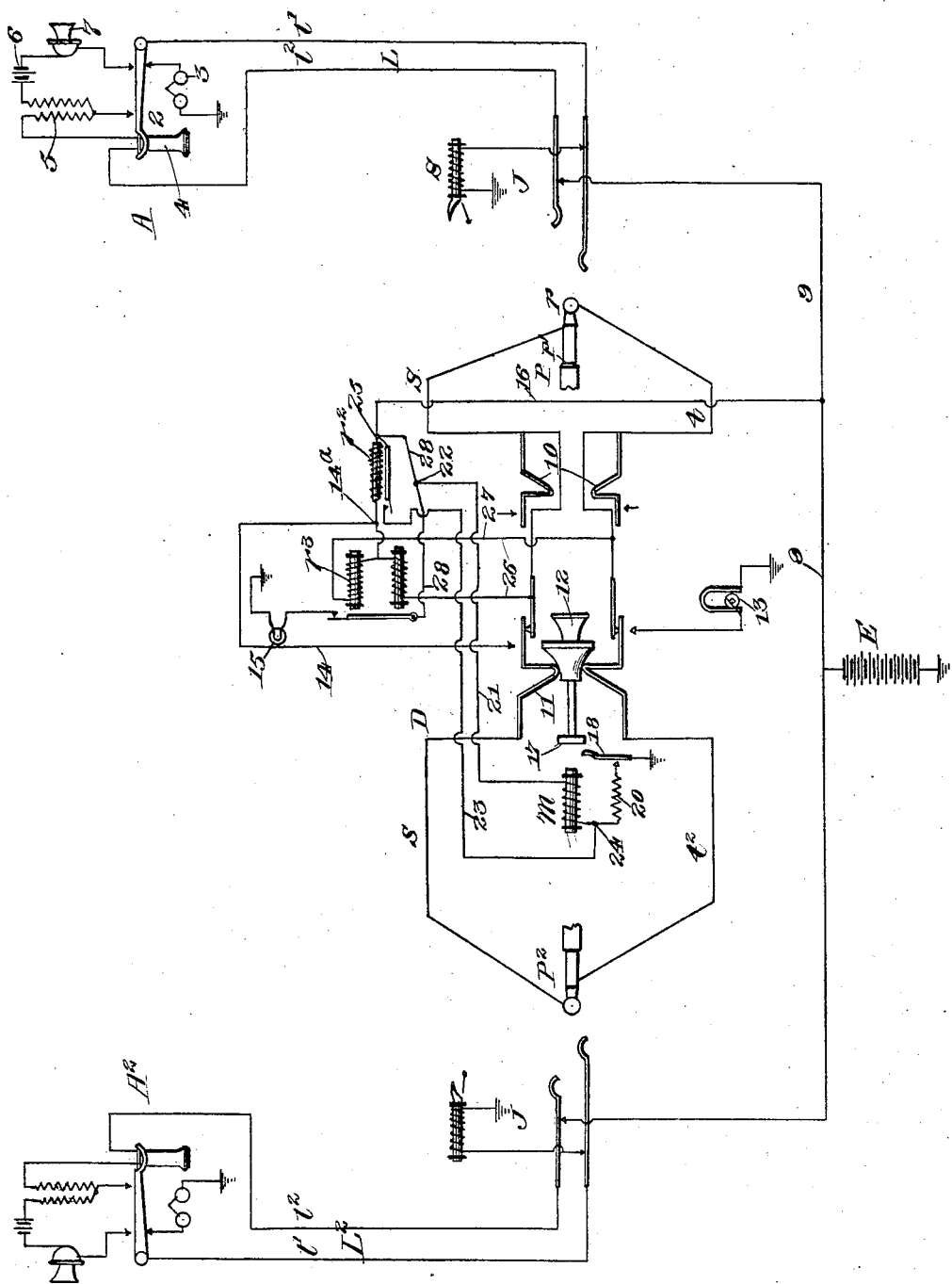


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H. P. CLAUSEN.
TELEPHONE SYSTEM.
APPLICATION FILED JULY 18, 1903.



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TELEPHONE SYSTEM.

No. 859,201.

Specification of Letters Patent.

Patented July 9, 1907.

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To all whom it may concern:

Be it known that I, HENRY P. CLAUSEN, a citizen of the United States of America, and a resident of Chicago, 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 wherein subscribers' lines terminate at a central office, at which office means, such as operators' circuits and devices are provided to variously connect the lines together for conversational purposes and perform the usual and necessary operations attendant upon such connections.

The ordinary and usual arrangement at a central office is to locate the switch sockets of the subscribers' lines upon the switchboard before the operators and to provide the operators each with a certain number of pairs of switching plugs, adapted to be inserted in the sockets of the lines, and having insulated contact surfaces to engage corresponding contact terminals in said sockets. The like contact surfaces of the pairs of plugs are connected by flexible conductive cords so that when the plugs of a pair are inserted in the sockets of two lines, the lines are electrically connected together for conversational purposes. Switches are also provided in order to enable the operator to insert her telephone into the cords, or cord circuits, as they are usually called, to enable her to talk with and receive the message from a calling subscriber, and to likewise connect the central office ringing generator with the cord circuits to ring a subscriber's bell. It will be apparent therefore, that to connect two subscribers' lines together for inter-communication, the operator is required to insert one plug of a pair into the line socket in response to the subscriber's call; to connect her telephone with the cords, to ascertain the number wanted, and, in accordance with the directions received, to insert the other plug of the pair into the wanted subscriber's switch-socket or jack, as it is sometimes termed, the final act of the series being to connect the ringing generator to the plug last inserted to call the connected subscriber. But in such systems where the several connective acts are wholly manual, the operator's attention must not be diverted from the established connection, for the called subscriber may not respond, in which case the usual operation is for the operator to connect her generator with the cords and ring his bell again. This throws additional work upon the operator besides causing loss of time to the waiting subscriber and to any others throughout the system who may be wishing to connect with the lines. It has been proposed to reduce the labor of the operator by making the disconnection of the calling generator from the cord circuit entirely automatic, so that after she has once inserted the plug into a called-for subscrib-

er's jack no further attention on her part is required as the response of the subscriber disconnects the generator.

It is to improvements in this line that my invention specifically relates. In carrying out my improvements, I provide means for automatically cutting off the ringing generator when the called subscriber responds, so that conversation may be carried on; and further means whereby the same disconnection takes place and a supervisory clearing-out signal is exposed, in case the waiting subscriber becomes impatient, hangs up his telephone and leaves the instrument. There is also a supervisory signal to indicate the termination of the conversation.

In the drawing which accompanies and illustrates the specification, the figure is a diagrammatic view indicating two telephone circuits entering a central office together with a switch-cord circuit arranged to unite them for the formation of a circuit for a through communication.

L and L² represent two telephone circuits extending between their respective sub-stations A and A² and a central station C. They are provided at the sub-stations with a telephone receiver 4 and a secondary winding of an induction coil 5 in a normally open branch or bridge between the main conductors L¹ and L², a call-bell 3 being arranged in a ground branch and the regular telephone switch being adapted while supporting the receiving telephone to maintain the normal discontinuity of the telephone bridge or branch as well as the local circuit containing the primary winding of the coil 5, and the local battery 6 to supply current for the transmitter 7. The grounded call-bell 3 is normally connected by the hook 2 with the main line conductor L¹, but is opened when the receiver is displaced, the telephone branch and the local circuit being closed at this time. At the central station these lines center in a switchboard where they are fitted each with switch-sockets or jacks J, a line signal S, each, moreover, being also in normal connection with a source of current E, such as a battery.

D represents a switch cord-circuit adapted to form an operative union between the two line circuits. The figure also shows the several appliances and circuit arrangements employed in carrying out the invention for the purpose hereinbefore indicated in their normal relation to one another.

P and P² are the switch plugs of ordinary structure, having a tip contact surface p and a sleeve contact surface p¹, which surfaces are adapted to register respectively, with corresponding line contact surfaces in the plug sockets or jacks J. These surfaces of one of the plugs are electrically connected with the reverse surfaces of the other, or tip to sleeve and vice versa, by the

strands or cords s , s^2 and t , t^2 , these strands being normally continuous through the resting contacts of the ringing key springs 11, a listening key, indicated by the springs 10, being provided to enable the operator to connect her telephone with the cord circuit.

The ringing key comprises as shown diagrammatically a spring operating means, as the plunger 12, adapted when depressed to break the continuity of the cord strands and connect the springs 11, with their outer contact anvils, the lower of such anvils being joined to the grounded ringing generator 13, while the upper is electrically connected with a branch conductor 14 extending to the junction 14^a, the function of which will be hereinafter described. An armature is carried by the ringing key 12 which when depressed is within the magnetic field of a magnet m whose circuit is closed through the resistance 20 by the armature 17 striking against the grounded contact spring 18, the other terminal of the winding of the magnet being connected by the conductor 21 to the junction 22. A short circuiting branch 23 for the magnet m extends from the point 24 to the front contact anvil of the relay r^2 , being completed by the armature of said relay to the junction 25.

A supervisory relay r^3 having double coils either of which is alone capable of attracting the armature, is bridged by the conductors 26 and 27 across the cord circuit, its coils having sufficient impedance to voice currents to prevent their passage thereacross. The middle point of these coils is connected by a conductor 16, to the battery lead 9 emerging from the battery E and connecting normally with the subscribers' lines for the operation of their signals. This conductor contains the windings of the relay r^2 before mentioned, and from the point 25 a conductor 28 leads to the armature of the supervisory relay r^3 which governs through its forward contact anvil, the circuit of lamp 15.

The ringing and listening keys may be of any mechanical structure which will successfully perform the desired operations.

In operation, the subscriber A, for example, indicates a call at the central station by taking up his receiver, which act closes the main conductors together, and forms a path from the battery E over the conductor 9, the metallic line circuit to the sub-station and back to the central station and through the signal S. It will be noticed that the line conductor l^2 with which the battery E is connected stands normally open at the subscriber's station so that there is no undue waste of current. The operator observing the signal inserts the answering plug P into the jacket or socket J, thus cutting off the battery E and the signal S which is also restored, and she then connects her head telephone with the cord circuit by means of the key springs 10. Upon learning the number of the party wanted, the calling plug P² is inserted in the jack of that subscriber, and the calling key plunger 12 depressed. The depression of said plunger connects the lower spring 11 with the generator 13 which sends ringing current out to the sub-station through the cord-strand t^2 , the line wire l^1 , the switch hook and through the call bell 3 to ground, thus ringing the subscriber's bell. The other spring 11 of the ringing key is now in contact with the terminal of wire 14. The armature 17 on the key plunger in its movement closed spring 18 upon its contact to cause the excitation of magnet m from the battery E over a circuit there-

from, including lead 9, conductor 16 to the junction 25, conductor 28 to the point 22, branch 21, winding of magnet m , resistance 20 and spring 18 to ground. This holds the armature and key in depressed position until the magnet m is deenergized in either of the following ways. First: If the called subscriber responds, a metallic path for the ringing current is provided back to the central office over the line conductor l^2 , the tip of the plug, strand s^2 , branch 14 to point 14^a, conductor 16 through relay r^2 to point 25; from here the current has two paths, one through 16 and 9 to the battery and earth, and the other through conductors 28 and 22, magnet m , resistance 20 and spring 18 to ground. The current now flowing through the relay r^2 , is sufficient to operate it, it being responsive to the alternating ringing current, and its armature closes the short circuit 23 about magnet m , the resistance 20 serving to prevent short circuiting the battery E, which magnet loses its magnetism and allows the plunger under the influence of its spring to return to normal position, thus breaking connection at the spring 18 and from the generator 13 and branch 14, and completing the cord circuit for through communication. The second manner of disconnecting the generator is when the waiting or calling subscriber hangs up his receiver. This completes a circuit for relay r^2 from the battery E, conductors 9 and 16, relay r^2 , the lower coil of relay r^3 , conductor 26, strand S of the cord circuit, main line conductor l^1 to ground through the signaling bell. This also causes the excitation of the relay r^2 to close the short circuit about magnet m to disconnect the generator 13, and at the same time it operates relay r^3 to light the supervisory lamp 15 from the battery E over conductors 9, 16, and 28. The operator seeing this signal may take down the connection. At the termination of the conversation, the replacement of the receiver at one sub-station will complete a circuit through one coil of relay r^3 as just traced, and a like act at the other station will close a corresponding circuit through the other coil, both coils of the relay thus being brought into operation for safety and convenience by the tip and sleeve connection of the cord strands as before described. The operator observing the lighting of lamp 15 will withdraw the plugs and take down the connection.

It is sometimes convenient to dispense with the auxiliary ground connections at the central station and in lieu thereof to provide return conductors or a common-return to the complementary battery pole. This, of course, is an immaterial change and may or may not be made, as preferred, by those practicing the invention.

As a matter of course, switchboard apparatus containing my invention will comprise as many switch-cord circuits as are necessary for the proper conduct of the business of switching lines together or to accommodate the traffic. Good results have been obtained with relay coils r^3 of 5000 ohms resistance, relay r^2 of 5000 ohms resistance, magnet m of 80 ohms and resistance 20 of 80 ohms resistance.

What I claim as my invention is:

1. In a telephone system, subscribers' lines, a cord circuit connecting said lines for conversation, a ringing key and a ringing generator to call the wanted subscriber, a magnet whose circuit is closed by the operation of the key in connecting the generator with the cord circuit to thereby hold the key in operated position, a relay connected with the cord circuit and controlling the continuity of a short

circuit about the magnet, said relay being operated by the response of the called subscriber to restore the key and all related parts to normal position.

2. In a telephone system, subscribers' lines, a cord circuit connecting said lines for conversation, a ringing key and a ringing generator to call the wanted subscriber, a magnet whose circuit is closed by the operation of the key in connecting the generator with the cord circuit to thereby hold the key in operated position, a relay connected with the cord circuit and controlling the continuity of a short circuit about the magnet, said relay being operated by the response of the called subscriber or by the replacement of the calling subscriber's receiver.

3. In a telephone system, subscribers' lines having grounded call-bells at the sub-stations, a cord circuit, a ringing generator, means to maintain said generator in connection with the cord circuit to signal the called subscriber, until the latter answers, a relay also connected with the cord circuit to control such means, said relay being operated by the ringing current when the called subscriber responds to disconnect said generator from the cord circuit together with a supervisory signaling device adapted to be brought into operation simultaneously with the operation of the means by which the calling subscriber automatically disconnects the source of ringing current from the called subscriber's line.

4. In a telephone system, subscribers' metallic lines, having grounded signaling bells, a cord circuit connecting two lines together, a grounded ringing generator connected with said cord circuit to ring the called subscriber's bell over one line conductor and ground, a relay connected between the other line conductor and ground at the central office, a magnet to hold the generator in connection with the cord circuit, and a short circuit about the magnet controlled by the relay.

5. In a telephone system, subscribers' metallic lines, having grounded signaling bells, a cord circuit connecting two lines together, a grounded ringing generator connected with said cord circuit to ring the called subscriber's bell over one line conductor and ground, a relay connected with the corresponding line conductor of the calling subscriber, a battery and ground at the central office, a magnet to hold the ringing generator in connection with the cord circuit, a short circuit of said magnet controlled by said relay, whereby when the calling subscriber hangs up his receiver the said relay is operated by battery current over one of the calling subscriber's line conductors and ground, to short circuit the magnet and disconnect the generator.

6. In a telephone system, subscribers' metallic lines, having grounded signaling bells, a cord circuit connecting two lines together, a grounded ringing generator connected with said cord circuit to ring the called subscriber's bell over one line conductor and ground, a grounded branch from the cord strand, two relays and a battery in said branch, a magnet to hold the generator in operative connection with the cord circuit, a short circuit of said magnet controlled by one of said relays and a supervisory signal controlled by the other, whereby when the calling subscriber replaces his instrument the relays are operated over the grounded line conductor to short circuit the magnet to disconnect the generator and expose the supervisory signal together with a supervisory signaling device adapted to be brought into operation simultaneously with the operation of the means by which the calling subscriber automatically disconnects the source of ringing current from the called subscriber's line.

7. In a telephone system, subscribers' metallic line circuits having call-bells grounded from one line conductor, a cord circuit connecting two lines for conversation and having its strands extending from the tip of one plug to the sleeve of the other, a ringing key adapted to sever the

cord strands, a grounded ringing generator connected with one strand of the calling plug to ring the called subscriber's bell, a magnet to hold the generator so connected, a relay to control said magnet, said relay being connected with the other strand of the cord circuit to both plugs and with a grounded battery, whereby when the called subscriber responds the said relay is operated by ringing current over his metallic line or when the calling subscriber replaces his receiver the relay is operated by battery current over one of his line conductors and ground, in either case to disconnect the generator.

8. In a telephone system, subscribers' metallic lines, having grounded bells, a cord circuit having its strands connected from the tip of one plug to the sleeve of the other, a ringing key, a grounded ringing generator, a magnet operated over a local circuit closed by the sound key to signal the called subscriber, a bridge of the cord circuit, a double coil relay in said bridge, a conductor extending from between the coils of the relay to the ground, a common battery and another relay in said conductor, a short circuit for said magnet controlled by the latter relay, another branch conductor from between the two relays closed by the ringing key to the line of the called subscriber, and a supervisory lamp controlled by said bridged relay.

9. In a telephone system, the combination of subscribers' lines, subscribers' hook switches, jacks connected with the lines, operators' cord circuits having plugs adapted for insertion in said jacks, bells associated with the said hook switches, a source of current associated with the said cord circuit and arranged to be connected with either line for the purpose of ringing either of said bells, an electric locking device for temporarily maintaining the connection between said source of current and the cord circuit, a normally open shunt around said electric locking device, a relay for opening and closing said shunt, and suitable connections whereby said relay may be controlled by either of said hook switches together with a supervisory signaling device adapted to be brought into operation simultaneously with the operation of the means by which the calling subscriber automatically disconnects the source of ringing current from the called subscriber's line.

10. In a telephone system, the combination of subscribers' bells, a source of current at the central station for ringing said bells, an electric locking device for maintaining the flow of current from said source until the called subscriber answers, or until the calling subscriber hangs up his receiver, a normally open shunt around said locking device, a supervisory relay, an auxiliary relay for opening and closing said shunt, a battery, and circuit connections whereby the circuit of said auxiliary relay includes said battery and said supervisory relay.

11. In a telephone system, the combination of a subscriber's line, a subscriber's bell, a source of current at the central station for ringing said bell, an electric locking device for causing a constant projection of ringing current onto the line, a supervisory electro-magnet connected and arranged to be energized when the subscriber answers the call, and electrically operated means in the circuit of said supervisory relay adapted and arranged to release said locking device when the subscriber answers the call together with a supervisory signaling device adapted to be brought into operation simultaneously with the operation of the means by which the calling subscriber automatically disconnects the source of ringing current from the called subscriber's line.

Signed by me at Chicago, Cook county, Illinois, this 15th day of July, 1903.

HENRY P. CLAUSEN.

Witnesses:

A. F. DURAND,
WM. A. HARDERS.