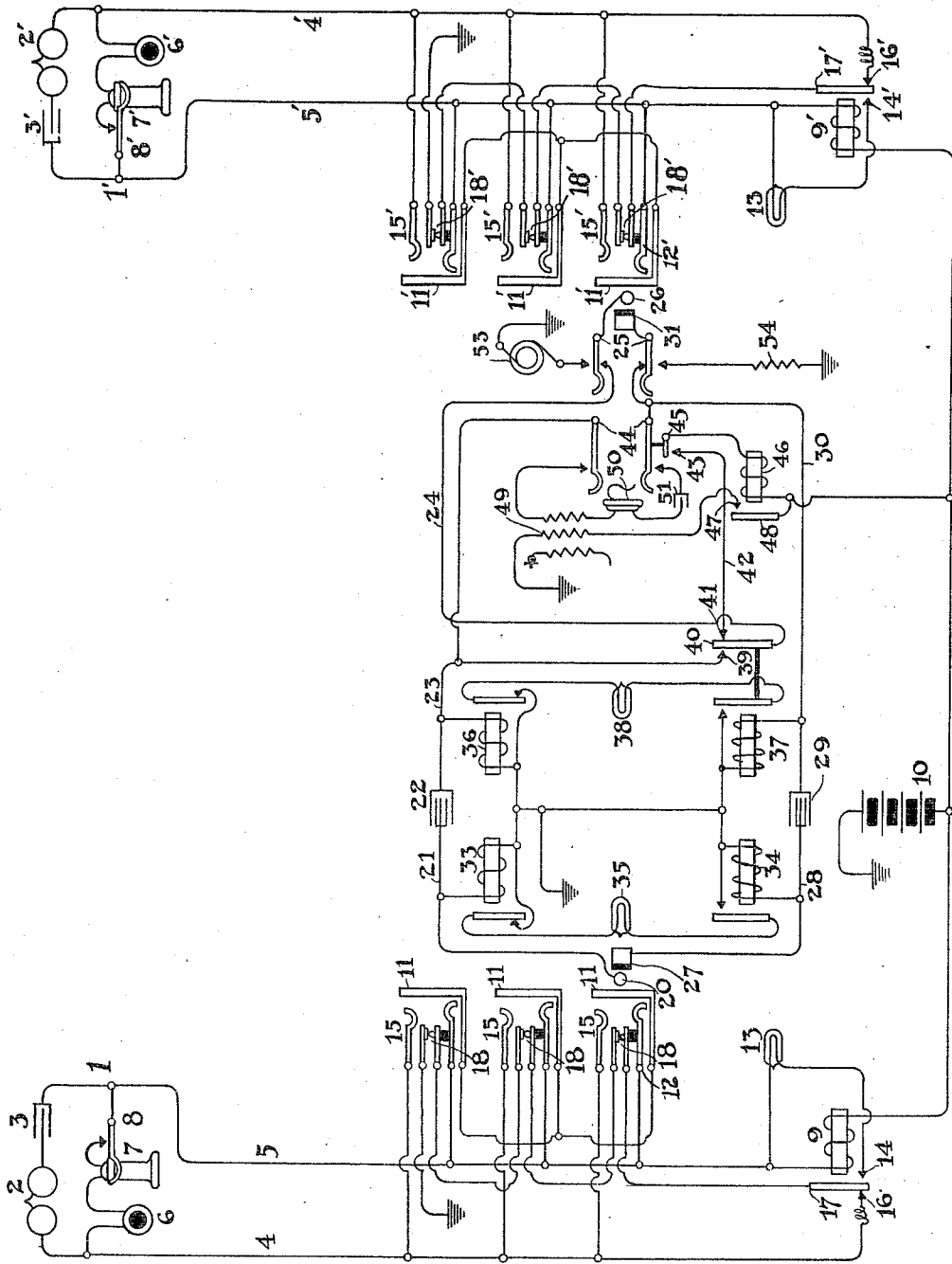


C. A. SIMPSON.
TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, CHARLES A. SIMPSON, a citizen of the United States, residing in Chicago, 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 of the central battery type and has for its object the simplification of the circuits and apparatus.

It has been customary in common battery systems to employ both line and cut-off relays individual to each telephone line, and by the present invention I am enabled to eliminate the cut-off relay and at the same time to maintain the advantages of the systems provided with both line and cut-off relays.

My invention is illustrated in the accompanying drawing in which the apparatus is shown in its normal or unactuated condition.

In the drawing, the calling substation 1 is provided with the annunciator 2 and condenser 3 in a permanent bridge between line conductors 4 and 5, and with the transmitter 6 and receiver 7 in a bridge maintained normally open by contacts of the switch hook 8.

At the central office, line conductor 5 is connected through the coil of line relay 9 with the live pole of battery 10. This conductor is also connected directly with the ring contacts 12 of the answering and multiple jacks. The line lamp 13 has one terminal connected with line conductor 5 and the other terminal connected with the normally open contact 14 of line relay 9. The other line conductor 4 is directly connected with the tip contacts 15 of the answering and multiple jacks and with the normally closed contact 16 of line relay 9. The spring contact 17 of line relay 9 is connected through the normally closed series contacts 18 of the answering and multiple jacks with earth. The additional sleeve or test contacts 11 are permanently connected together through a conductor of the multiple cable. The answering subscriber's line illustrated at the right of the sheet is provided with apparatus similar to that of the calling line, the corresponding apparatus being designated by like figures with the suffix "'". The cord circuit for connecting these lines for conversation has tip and sleeve talking strands,

the tip strand extending from the tip 20 of the answering plug through conductor 21, condenser 22, conductors 23 and 24 including normally open contacts of answering sleeve relay 37, and the series contacts of the ringing key 25 to the tip contact 26 of the calling plug, and the sleeve strands extend from the sleeve contact 27 of the answering plug through conductor 28, condenser 29, conductor 30 and the series contacts of ringing key 25 to the sleeve contact 31 of the calling plug. The tip and sleeve answering supervisory relays 33 and 34 are connected in a bridge between the cord conductors 21 and 28, the portion of this bridge between the coils of said relays being connected to earth. The relay 34 is preferably of comparatively high resistance, it being actuated during connection over a local circuit. The relay 33 is of low resistance, one-hundred ohms being found satisfactory, so that the transmitter current may be fed to the line through its coil. Relays 33 and 34 jointly control the circuit of the supervisory signal 35, relay 34 being adapted when actuated to complete the circuit of the supervisory signal, and relay 33 being adapted when actuated to interrupt the circuit of said signal. The calling supervisory relays 36 and 37 are similarly connected in a bridge between conductors 23 and 30, these relays being similarly arranged to control the circuit of supervisory signal 38. The relay 37 has the additional contacts 39, 40 and 41, the contacts 39 and 40 maintaining a normal separation between the portions 23 and 24 of the tip talking strand, and the contacts 40 and 41 maintaining a normal connection between the strand 24 and conductor 42, which conductor extends to the normally open auxiliary contact 43 of the operator's listening key 44. The other auxiliary contact 45 is connected through the test relay 46 with the live pole of battery 10. This relay 46 controls the normally open contacts 47 and 48 adapted when closed to complete the circuit of the battery through the tertiary winding 49 of the operator's induction coil. The listening key 44 is adapted when actuated to place the operator's receiver 50, the secondary of the induction coil and condenser 51 in a bridge between the tip and sleeve strands of the cord circuit.

The operator's ringing key 25 is adapted when actuated to connect the tip of the call-

ing plug with the alternating current generator 53, and to connect the sleeve of the calling plug through the non-inductive resistance 54 with the grounded pole of said generator.

The connecting plugs used in this system are provided with long sleeves which connect both with the ring and test contacts. A ring of insulation separates the tip and sleeve contacts so that as the plug is withdrawn from the jack the ring contact of the jack will disconnect from the sleeve of the plug before the contacts 18 are closed.

In the operation of my system, the subscriber in charge of substation 1 removes his receiver 7 from the switch hook 8 and thus completes a circuit from the live pole of battery 10 through the coil of line relay 9, conductor 5, switch hook 8, receiver 7, transmitter 6, line conductor 4, contacts 16 and 17 of line relay 9 and series contacts 18 of the answering and multiple jacks to earth. Current in this path actuates relay 9 which is preferably so constructed as to complete the contacts 14 and 17 before contacts 16 and 17 are interrupted. The actuation of this relay completes the circuit of the line lamp 13 from the live pole of battery 10 through the coil of line relay 9, line lamp 13, contacts 14 and 17 of relay 9 and series contact 18 of the answering and multiple contacts to earth. The display of signal 13 attracts the attention of the operator who inserts the answering plug into the answering jack of the calling line and thereby interrupts the circuit through the series contacts 18 and also completes a circuit from the live pole of battery 10 through the coil of line relay 9, ring contacts 12 and 27 of the jack and plug and the coil of supervisory relay 34 to earth. The current in this path maintains the actuation of line relay 9 and actuates supervisory relay 34. A second circuit is also completed by the insertion of the plug, this circuit including the coil of relay 9, line conductor 5, switch hook 8, receiver 7, transmitter 6, line conductor 4, tip contacts 15 and 20 of the jack and plug, conductor 21 and the coil of supervisory relay 33 to earth. The actuation of relay 33 prevents the display of the supervisory signal 35 which would otherwise have been displayed by the actuation of supervisory relay 34. The operator now actuates her listening key 44 and obtains the number of the desired line. Finding this to be the line of substation 1', the operator touches the tip contact 26 of her calling plug to the sleeve contact of one of the multiple jacks of said line. If the desired line is busy another cord circuit will be connected with one of the jacks of said line and the sleeve contact will therefore be maintained at a potential lower than that of battery 10. Current will therefore flow from the live pole of battery

10 through the coil of the test relay 46 which is preferably of very high resistance, the now closed contacts 45 and 43 of the operator's listening key 44, conductor 42, contacts 41 and 40 of supervisory relay 37, tip conductor 24 and the tip contacts of the ringing key 25 through the tip of the plug to the sleeve contact of the jack thus tested. The current in this path will actuate the test relay 46 and close its contacts 47 and 48, thus sending an impulse of current through the tertiary winding of the operator's induction coil, causing a disturbance in the secondary of the coil which is heard in the operator's receiver. Assuming, however, that the desired line is found idle, the operator inserts her calling plug into the jack of the desired line and actuates her ringing key 25. This connects alternating current from the generator 53 through the tip contacts of the ringing key over the tip contacts 26 and 15' of the plug and jack, line conductor 4', annunciator 2', condenser 3', line conductor 5', ring contacts 12' and 31 of the jack and plug, sleeve contacts of the ringing key 25 and through the non-inductive resistance 54 to earth. The current in this path being alternating in character, passes through the condenser 3' and sounds the annunciator 2' calling the desired subscriber to his telephone.

Upon the release of the ringing key and before the desired subscriber answers his call, a circuit is completed from the live pole of battery 10 through the coil of line relay 9', contacts 12' and 31 of the jack and plug, series contacts of ringing key 25, conductor 30 and the coil of supervisory relay 37 to earth. Current in this path actuates relays 37 and 9', the actuation of relay 37 completing the circuit of supervisory signal 38 which indicates to the operator that the called subscriber has not yet answered his call.

When the called subscriber answers his call, a circuit is completed from the live pole of battery 10 through the coil of line relay 9', conductor 5', switch hook 8', receiver 7', transmitter 6', conductor 4', tip contacts 15' and 26 of the jack and plug, series contacts of ringing key 25, conductor 24, the now closed contacts 40 and 39 of supervisory relay 37, conductor 23 and the coil of supervisory relay 36 to earth. The current in this path actuates relay 36 which interrupts the circuit of the supervisory signal 38, thus effacing said signal to indicate to the operator that the called subscriber has answered his call. When the conversation is terminated and the subscribers replace their receivers upon their respective switch hooks the circuits of supervisory relays 36 and 33 are interrupted causing the contacts of those relays to resume their normal positions, which causes the dis-

play of supervisory signals 35 and 38. When the operator observes the display of these signals she removes her calling and answering plugs from their connections with the jacks and thus severs the circuits of relays 34 and 37 and of line relays 9 and 9'. When these relays resume their normal positions the signals at the central office are all effaced and the apparatus is in condition for another call.

It is to be understood that I have here shown and described my invention with respect to certain details to which I do not wish to be unduly limited, it being possible to make certain modifications of these details without departing from the spirit or scope of my invention.

I claim:

1. In a telephone system, the combination with a telephone line, of a source of current, a relay having its coil normally connected between a pole of said source and a limb of said line, and the other limb of said line being normally connected with the other pole of said source through contacts of said relay, a line lamp, the actuation of said relay being adapted to complete a locking circuit through said line lamp and the coil of said relay, substantially as described.
2. In a telephone system, the combination with a telephone line, of a central source of current, a relay having its coil permanently connected between a pole of said source and a limb of said line, the other limb of said line being normally connected with the other pole of said source through contacts of said relay and through series contacts of the answering and multiple jacks, a line lamp, the actuation of said relay being adapted to complete the circuit of said lamp through the contacts of said jacks and the coil of said relay, substantially as described.
3. In a telephone system, the combination with a telephone line, of a central source of current, a relay permanently connected between a pole of said source and a limb of said telephone line, the other limb of said line being normally connected through contacts of said relay and contacts of the answering and multiple jacks with the other pole of said source, a line lamp, the circuit of said lamp being adapted to be completed through the contacts of said jacks and contacts of said relay when the relay is actuated, a cord circuit to connect with said jacks, the connection of the cord circuit with said jacks being adapted to open the contacts of said jacks to efface the line lamp, substantially as described.
4. In a telephone system, the combination with a telephone line, of a source of current at the central office, a line relay permanently in series with said line, a locking circuit for said relay, a line lamp in said locking circuit, the removal of the receiver at the sub-station being adapted to initially actuate said line relay and to display said line lamp, said relay being maintained actuated over its locking circuit, and a cord circuit adapted when connected with the line to effect the interruption of said locking circuit, substantially as described.
5. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith for conversation, a central source of current, a relay for the line permanently connected with one pole of said source, and a relay for the cord circuit permanently connected with the other pole of said source, said cord relay and said source being adapted to be connected in a bridge of the talking circuit during conversation, a line lamp for the line adapted to be displayed by the actuation of said line relay, means adapted upon actuation of the line relay to remove sub-station control of said signal, auxiliary contacts associated with the connecting jack of said line adapted to be separated by the connection of the cord with the line, a signal associated with the cord circuit, the actuation of said cord relay being adapted to prevent the display of said signal, substantially as described.
6. In a telephone system, the combination with a telephone line, of a jack for said line having talking contacts permanently connected with the limbs of said line, a central source of current, a relay permanently connected between a pole of said source and a limb of said line, the other limb of said line being normally connected through contacts of said relay and contacts of said jack, in the order named, with the other pole of said source, a line lamp connected between the first named limb of said line and a normally open contact of said relay, the actuation of said relay being adapted to complete the circuit of said lamp through the contacts of said jack, the contacts of said relay and the coil of said relay, whereby the relay is locked in its actuated condition and the lamp is displayed, the second limb of the line being disconnected from said source at contacts of said relay when the relay is actuated, the locking circuit of said relay including said line lamp being adapted to be interrupted by the separation of the contacts of the jack when a connection is established with the line, substantially as described.
7. In a telephone system, the combination with a telephone line, of a single relay for said line, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, contacts of said jack adapted when separated to interrupt the circuit of said signal, said relay thereafter remaining energized over the telephone line, the talking contacts of said jack being permanently connected with the limbs of said telephone

line and one limb of said line being interrupted at contacts of said relay during conversation, substantially as described.

8. In a telephone system, the combination with a telephone line, a battery at the central office for furnishing current to the substation apparatus, of a locking line relay for said line energized from said source, a signal controlled thereby, a cut-off jack associated with the line and having contacts in the circuit of said signal during its actuation, a cord circuit, the connection of the cord circuit with the line being adapted to separate the contacts of said cut-off jack, whereby the signal is effaced, substantially as described.

9. In a telephone system, the combination with a telephone line, of cut-off jacks for said line, a central source of power, a line relay for the line, a locking circuit for said relay, a line signal adapted to be displayed by the actuation of said line relay, a cord circuit adapted to be connected with the line for conversation, the limbs of said cord circuit being directly connected with the limbs of said line, substantially as described.

10. In a telephone system, the combination with a telephone line, of cut-off jacks for said line, a central source of power, a line relay for the line, a line signal adapted to be displayed by the actuation of said line relay, the circuit of said signal including the coil of said relay, a cord-circuit adapted to be connected with the line for conversation, the limbs of said cord-circuit being directly connected with the limbs of said line, substantially as described.

11. In a telephone system, the combination with a telephone line, of a single relay for said line secured to the sleeve side thereof, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, a locking circuit for said relay controlled through contacts of said jack, the said contacts of said jack being adapted, when separated, to interrupt the circuit of said signal, substantially as described.

12. In a telephone system, the combination with a telephone line, of a single relay for said line secured to the sleeve side thereof, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, contacts of said jack included in the actuating circuit of said relay, the said contacts of said jack being adapted, when separated, to interrupt the circuit of said signal, the talking contacts of said jack being permanently connected with the limbs of said telephone line, substantially as described.

13. In a telephone system, the combination with a telephone line, of a single line relay therefor, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, contacts of said jack in-

cluded in the actuating circuit of said relay, the said contacts of said jack being adapted, when separated, to interrupt the circuit of said signal, and a local circuit for said relay as long as the plug is inserted in the jack, substantially as described.

14. In a telephone system, the combination with a telephone line, of a single line relay therefor, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, contacts of said jack included in the actuating circuit of said relay, the said contacts of said jack being adapted, when separated, to interrupt the circuit of said signal, and a local circuit for said relay having a part coincident with the talking circuit, substantially as described.

15. In a telephone system, the combination with a telephone line, of a single line relay therefor, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, contacts of said jack adapted, when separated, to interrupt the circuit of said signal, the path for said line relay during conversation being completed over the telephone line and the tip strand of said cord-circuit as long as the receiver is off the hook, and over the sleeve strand of the cord-circuit as long as the plug is in the jack, substantially as described.

16. In a telephone system, the combination with a telephone line, of a single line relay for said line, a line signal adapted to be displayed by the actuation of said relay, means effective upon actuation of said relay to remove sub-station control of said signal, a jack for said line, contacts of said jack adapted, when separated, to interrupt the circuit of said signal, a supervisory signal and a pair of relays for controlling the operation thereof, said line relay being in series with one of said supervisory relays during conversation, whereby said signal is at that time rendered inert, substantially as described.

17. In a telephone system, the combination with a telephone line, of a single line relay for said line, a line signal adapted to be displayed by the actuation of said relay, a jack for said line, contacts of said jack adapted, when separated, to interrupt the circuit of said signal, a supervisory signal and a pair of relays for controlling the operation thereof, said line relay being in series with one of said supervisory relays as long as the plug is in the jack, whereby said signal is at that time placed in condition to operate, substantially as described.

18. In a telephone system, the combination with a telephone line, of a single line relay for said line, a line signal adapted to be displayed by the actuation of said relay, means effective upon actuation of said relay to remove sub-station control of said signal, a jack for said line, contacts of said jack

adapted, when separated, to interrupt the circuit of said signal, a supervisory signal and a pair of relays for controlling the operation thereof, said line relay being in series with both of said supervisory relays, substantially as described.

19. In a telephone system, the combination with a telephone line, of a single line relay therefor, a cord-circuit for making connection with the line, a supervisory relay associated with each strand of the cord-circuit, a signal for the line placed in operative condition by the actuation of said line relay, and local jack contacts for rendering said line signal inert when the cord is con-

nected with the line, the path for current of said line relay during conversation including the telephone line and the winding of said tip supervisory relay, said line relay being independently energized over a local circuit including the winding of the sleeve supervisory relay, substantially as described.

Signed by me at Chicago, county of Cook, and State of Illinois, in the presence of two witnesses.

CHARLES A. SIMPSON.

Witnesses:

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