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TELEPHONE SYSTEM.

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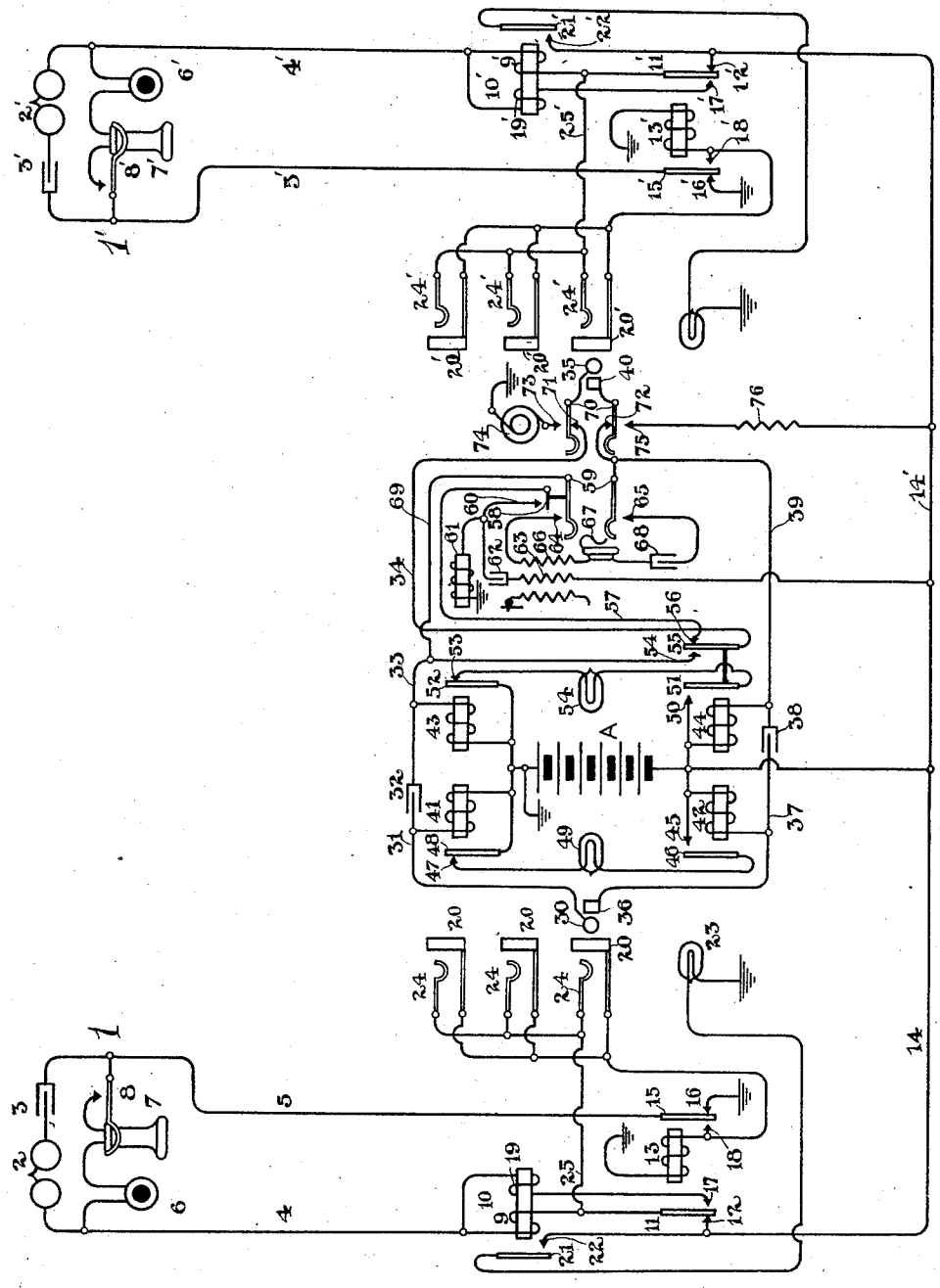

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# UNITED STATES PATENT OFFICE.

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## TELEPHONE SYSTEM.

1,002,891. Specification of Letters Patent. **Patented Sept. 12, 1911.**

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*To all whom it may concern:*

Be it known that I, CHARLES S. WINSTON, 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 energy type having two-point jacks at the central office.

The object of my invention is to improve that class of systems having a relay in the talking circuit of the line rendered inert by contacts of the cut-off relay during a connection.

The present invention contemplates placing a second coil about the core of the line relay, the second coil being wound so as to neutralize the magnetic effect of the actuating coil when the cut-off relay is actuated, thereby causing the line relay to fall back and control the circuit of the line lamp.

My invention is illustrated in the accompanying drawing in which the circuits are shown for connecting substation 1 with substation 1′. Substation 1, which is here shown as the calling substation, is provided with the annunciator 2 and condenser 3 in a normally closed bridge between line conductors 4 and 5, and with transmitter 6 and receiver 7 in a bridge between the line conductors maintained normally open by contacts of switch-hook 8.

At the central office the line conductor 4 is connected through the coil 9 of the line relay 10 and through contacts 11 and 12 of cut-off relay 13, and conductor 14 with the live pole of battery A. Line conductor 5 is normally connected with ground through contacts 15 and 16 of cut-off relay 13. Cut-off relay 13 also has the normally disconnected contacts 17 and 18, contact 17 being connected with line conductor 4 through the coil 19 of line relay 10, and contact 18 being connected with the coil of relay 13 and with the sleeve conductors 20 of the answering and multiple jacks. Line relay 10 controls the normally open contacts 21 and 22 in the circuit of line lamp 23. The tip contacts 24 of the answering and multiple jacks are connected through conductor 25 with the line conductor 4 at a point between the coil 9 of relay 10 and the spring 11 of relay 13.

The answering telephone line 1′ is equipped with identical apparatus, the corresponding apparatus of this line being designated by like figures with the suffix "′".

The cord circuit for connecting the calling and called subscribers' lines for conversation is provided with tip and sleeve talking conductors extending respectively from the tip 30 of the answering plug through conductor 31, condenser 32, conductors 33 and 34 to the tip 35 of the calling plug, and from the sleeve 36 of the answering plug through conductor 37, condenser 38, and conductor 39 to the sleeve 40 of the calling plug.

The tip and sleeve supervisory relays 41, 42, 43 and 44 are connected in a bridge between the talking strands, this bridge including the main battery A. Relays 41 and 42 are connected upon the answering side of the condensers 32 and 38 and control contacts 45, 46, 47 and 48 in the circuit of supervisory signal 49, while relays 43 and 44 are similarly connected on the calling side of condensers 32 and 38 and control contacts 50, 51 52 and 53 in the circuit of supervisory signal 54. The relay 44 also controls normally open contacts 54 and 55 in the circuit of the tip talking strand and the normally closed contacts 55 and 56 in the circuit of the test conductor 57. This test conductor is connected with the contact 58 of the operator's ringing key 59, the contact 58 being adapted to connect with contact 60 when the key is thrown, and thence connecting with earth through the impedance coil 61 and with the live pole of battery and through condenser 62 and the tertiary 63 of the operator's induction coil.

The operator's listening key has the normally open contacts 64 and 65 which connect with the secondary 66, receiver 67 and condenser 68 of the operator's listening circuit. The tip spring of the listening key 59 is connected through conductor 69 with the tip strand 33 at a point on the answering side of the break in the tip strand which is normally maintained by contacts 54 and 55 of relay 44.

The operator's ringing key 70 has the series contacts 71 and 72 normally completing the tip and sleeve talking strands. The tip spring of the key being adapted to connect with contact 73 which connects with the ringing generator 74, the sleeve spring being adapted to connect with contact 75

which is connected with the live pole of battery A through the non-inductive resistance 76 and conductor 14'.

The subscriber in charge of substation No. 1 desiring to communicate with the subscriber in charge of substation 1', removes the receiver 7 from switch-hook 8, thus completing the circuit from the live pole of battery A over conductor 4, through transmitter 6, receiver 7, switch-hook 8, line conductor 5 and contacts 15 and 16 of cut-off relay 13. Current in this path actuates line relay 10, closing its contacts 21 and 22 and thereby completing the circuit of the line lamp 23 and displaying that signal. The operator upon observing the display of signal 23 inserts her answering plug into the answering jack, thereby completing the connection between contacts 24 and 30 contacts 20 and 36 of the plug and jack. When this operation is completed a circuit is formed from the live pole of battery A through the coil of relay 42, over the sleeve contacts of the plug and jack, and through the coil of relay 13 to earth. Relay 13 is ordinarily of high resistance and requires for its actuation only a small portion of the current which may pass through the low resistance coil of relay 42. Relays 13 and 42 are actuated by this current, the actuation of relay 13 completing the path for current from the point 18 through its now closed contact 15, line conductor 5, contacts of the switch-hook 8, receiver 7, transmitter 6, line conductor 4 and the coils 9 and 19 of relay 10 in parallel, the current passing through the coil 19 and through contacts 17 and 11 of cut-off relay 13, uniting with that passing through coil 9, and passing together over conductor 25 through contacts 24 and 30 of the jack and plug and through the coil of relay 41 to the ground pole of battery A. The equal currents through the coils 9 and 19 of line relay 10 neutralize the core of that relay, thus allowing the contacts to fall back, again opening the circuit of line signal 23, and effacing that signal. The actuation of relays 41 and 42 leaves the supervisory signal 49 in its normal condition, contacts 45 and 46 now being closed and contacts 47 and 48 now being open. The operator now operates her listening key 59, placing her receiver in a bridge between the talking conductors, and asks the desired number. This number being obtained, the operator raises her calling plug and touches its tip 35 to the sleeve contact of one of the multiple jacks of the desired line. Supposing the desired line to be busy, the sleeve contact of one of its jacks will be in connection with the sleeve contact of another operator's cord circuit and will therefore be maintained at a potential higher than that of ground. Current will therefore flow from the sleeve contact 20' over tip 35, series contacts of the operator's ringing key 70, tip conductor 34, contacts 55 and 56 of supervisory relay 44, conductor 57, now closed auxiliary contacts 58 and 60 of the operator's listening key 59 and through the impedance coil 61 to earth. Current in this path will slightly change the potential of the terminals of condenser 62, causing a partial discharge of that condenser, thus causing a disturbance in the tertiary 63 of the operator's induction coil, this disturbance being inductively reproduced in the secondary of the coil and therefore in the operator's receiver, indicating to the operator that the line is busy. If, however, the line is idle and no click is received by the operator the calling plug is completely inserted in the jack and the ringing key 70 is thrown. This connects the tip 35 through contact 73 with the generator 74 and connects the sleeve 40 through contact 75 and the non-inductive resistance 76 with the live pole of battery A. Current from battery A now flows through the non-inductive resistance 76, the closed contact 75 of the ringing key, the sleeve contacts 40 and 20' of the plug and jack, and through the coil of cut-off relay 13' to ground. Current in this path actuates the cut-off relay moving its contacts to their abnormal positions. As soon as the contacts of the cut-off relay 13' assume their actuated positions the circuit is completed from the ringing generator 74 through contacts 73 of the ringing key 70 over the tip contacts 35 and 24' of the plug and jack through the coils 9' and 19' of line relay 10', line conductor 4', annunciator 2', condenser 3', line conductor 5', the now closed contacts 15' and 18', sleeve contacts 20' and 40 of the jack and plug, contact 75 of the ringing key, non-inductive resistance 76, conductor 14' through the main battery A to earth and thence back to the generator 74. The alternating current in this path passes through the condenser 3', and operates the annunciator 2' calling the subscriber to his phone. As soon as the ringing key 70 is released a new path is completed from the live pole of battery A which includes the coil of relay 44, conductor 39, contact 72 of the ringing key 70, sleeve contacts 40 and 20' of the plug and jack and the coil of cut-off relay 13'. Current in this path actuates relay 44 closing its contacts 50 and 51, thereby completing the circuit of the supervisory signal 54 and displaying that signal to indicate to the operator that the called subscriber has not yet answered his call.

Upon the response of the called subscriber, a circuit is completed from the contact 18' of the cut-off relay 13' through the contact 15', line conductor 5', switch-hook 8', receiver 7', transmitter 6', line conductor 4', the windings 9' and 19' in parallel of the line relay 10', through conductor 25', the tip contacts 24' and 35 of the jack and plug,

tip conductor 34, the now closed contacts 55 and 54 of relay 44, conductor 33 and the coil of relay 43 to the ground pole of battery A. Current in this path actuates relay 43 and opens its contacts 52 and 53 in the circuit of supervisory signal 54, thus causing that signal to be effaced, indicating to the operator that the called subscriber has answered his call. The calling and called subscribers are now in condition for conversation, the voice currents passing over the line conductors through the opposed windings 9 and 19 and 9′ and 19′ of the line relays 10 and 10′ through the contacts of the jacks and over the tip and sleeve conductors and through the condensers 32 and 38 in the cord circuit. Transmitter current is furnished to the subscribers' lines through the coils of relays 41, 42, 43 and 44, these relays having sufficient impedance to the voice currents to prevent the short circuiting of the conversation through the main battery A.

While my invention is shown and described with respect to certain details and combinations, and while apparatus of a conventional form is shown in the drawing it is to be understood that I do not wish to be unduly limited thereto, certain variations being possible 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 line relay therefor having differential coils, a source of direct current, one of the coils being normally in the line and in the path of direct and voice currents during conversation, and the other coil being connected in parallel with the first coil when a connection is established with the line, whereby the effect of the first coil is neutralized, substantially as described.

2. In a telephone system, the combination with a telephone line, of a source of current at the central office normally connected in the circuit of the line, a line relay having a winding in the circut of the line and in the path of voice currents during conversation, a second differential winding for said relay placed in the circuit of the line when a connection is established therewith to neutralize the effect of the first winding, substantially as described.

3. In a telephone system, the combination with a telephone line, of a source of current at the central office normally connected with the line, a line relay, a cut-off relay, the line relay having a coil normally in series with the line, a second coil for the line relay adapted to be placed in series with the line by the actuation of the cut-off relay, whereby the magnetic effect of the first coil will be neutralized, substantially as described.

4. In a telephone system, the combination with a telephone line, of a cut-off relay for the line, a line relay having a coil normally in series with one of the limbs of the telephone line, a second coil for said line relay having its circuit maintained normally open by contacts of the cut-off relay and adapted to be placed in parallel with the first coil when a connection is established with the line, the two coils of said relay being differentially connected, whereby the relay will not be magnetized, substantially as described.

5. In a telephone system, the combination with a telephone line, of a source of current normally connected therewith, a pair of relays for the line, one of said relays having a coil normally in series with the line, and a coil normally in a circuit maintained open by contacts of the other relay, and means to energize the second relay when a connection is established with the line, whereby both of the coils of the first relay will be energized, said coils being differentially wound, whereby the magnetism of the relay will be neutralized when both of the coils are energized, substantially as described.

6. In a telephone system, the combination with a telephone line, of a cut-off relay therefor, a source of current normally connected with the line through contacts of the cut-off relay, a line relay having a coil normally in series with the line and said source, a second coil for the line relay adapted to be placed in parallel with the first coil by the actuation of the cut-off relay, and means to energize the cut-off relay when a connection is established with the line, substantially as described.

7. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a source of current normally associated with the line and permanently associated with the cord circuit, a line relay having a coil normally in series with one of the limbs of the telephone line and the source normally connected therewith, a differential coil for said line relay adapted to be placed in parallel with the first winding and in series with the said line and said source when the cord is connected with the line, and means to disconnect the source from its normal connection with the line and to place the coils of the line relay in parallel, whereby the core of the relay will become neutral, substantially as described.

8. In a telephone system, the combination with a telephone line, of a line relay normally in series in the line, a cut-off relay energized over a portion of the talking circuit, a differential coil for the line relay placed in parallel with the actuating coil of said relay when the cut-off relay is actuated, and a signal controlled by the line relay, substantially as described.

9. In a telephone system, the combination

with a telephone line, of a pair of relays for the line, a source of current normally connected with the line through the contacts of one of said relays, the other of said relays having a coil in series with the line, a differential winding for the latter relay adapted to be energized when a connection is established with the telephone line, whereby the magnetic effect of the first coil is neutralized, and a line signal controlled by the line relay, substantially as described.

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

CHARLES S. WINSTON.

Witnesses:

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