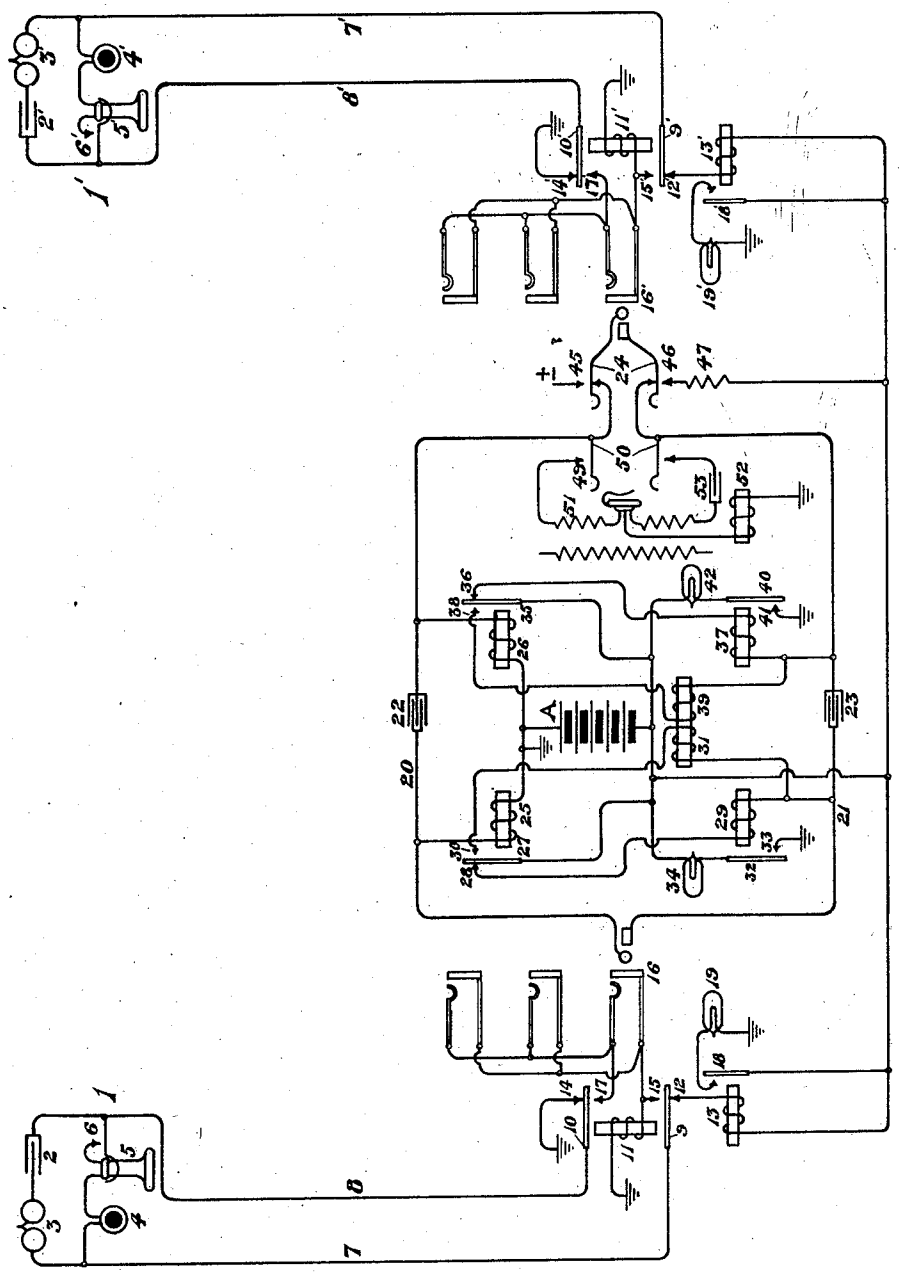
C. S. WINSTON.

TELEPHONE SYSTEM.

APPLICATION FILED APR. 15, 1907.

1,010,471. Patented Dec. 5, 1911.



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TELEPHONE SYSTEM.

1,010,471. Specification of Letters Patent. Patented Dec. 5, 1911.

Application filed April 15, 1907. Serial No. 368,192.

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, and especially to the arrangement of circuits and apparatus at the central office associated with the cord circuit used in connecting two lines for conversation.

The object of my invention is to simplify such connecting circuits, and particularly to produce a more nearly balanced talking circuit for the so-called two conductor systems. In the systems of this class in which the telephone lines are provided with cut-off relays connected between a third conductor and one of the limbs of the talking circuit during conversation, and in which the cord circuit is provided with a relay adapted to be actuated in series with the cut-off relay when the cord is connected with the line, it has been customary in the past to wind the cord relay to a comparatively low resistance, such that the transmitter energization current could be fed through the coil of this relay to the telephone line. In order to make this cord relay work positively when the cord circuit was connected with a line it was necessary to wind the cut-off relay to a resistance so low that it was sometimes found to unbalance the talking conditions on the line.

By my present invention I make my cut-off relay of high resistance and wind my cord relay to substantially the same resistance as the cut-off relay, and then I provide means for substituting in lieu of the cord relay an impedance coil of the proper resistance to furnish the line with transmitter energization current.

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

The substation 1 is provided with the condenser 2, and annunciator 3, serially connected between the limbs of the telephone line, and with the transmitter 4 and receiver 5 adapted to be placed in parallel with the annunciator and condenser when the receiver is removed from the hook switch 6. From this substation the line wires 7 and 8 extend to the springs 9 and 10 of the cut-off relay 11 located at the central office. Spring 9 is normally connected through the outside contact 12 with the live pole of battery through the coil of the line relay 13, which controls normally open contacts 18 in the circuit of the line lamp 19, while spring 10 is normally connected through the outside contact 14 with the ground pole of battery. One terminal of the coil of cut-off relay 11 is connected with the ring or test contact of the answering and multiple jacks 16 and with its own inside contact 15, adapted to be engaged by spring 9 when the relay is actuated. The tip contacts of these jacks are connected with the inside contact 17 of the cut-off relay, which contact is engaged by the spring 10 when this relay is actuated.

The subscriber's line at the right-hand side of the drawing is similarly equipped, the apparatus at this end of the drawing being designated by like numerals with the suffix " ′ ". The cord circuit adapted to connect lines of this system for conversation is provided with the tip and sleeve conductors 20 and 21, these conductors being conductively interrupted by condensers 22 and 23 and containing normally closed contacts in the ringing key 24. The supervisory relay 25 is connected between the ground pole of the main battery A and the tip strand of the cord circuit, on the answering side of the condenser 22. The relay 25 has the armature 27 permanently connected with the live pole of battery A, and normally connected through its contact 28 with the coil of relay 29, the other terminal of the coil of relay 29 being connected with the sleeve strand 21 of the cord circuit on the answering side of the condenser 23. Relay 25 also has the normally disconnected contact 30, which connects through the impedance coil 31 with the sleeve conductor 21 on the answering side of condenser 23. The relay 29 has normally open contacts 32 and 33 adapted when closed to connect the signal 34 in series with the main battery A. The relay 26 is similarly connected on the calling side of condenser 22 and is provided with the armature 35 normally connected through its contact 36 and the coil of relay 37 with the sleeve strand 21 on the calling side of condenser 23. Relay 26 also has the normally disconnected contact 38 connecting through the impedance coil 39 with the sleeve strand 21 of the cord circuit on the calling side of the condenser 23. Relay 37 controls contacts 40 and 41 in the circuit of the

supervisory signal 42, this signal being associated with the calling end of the cord circuit.

The ringing key 24 is adapted to sever the tip and sleeve of the calling plug from the remaining parts of the cord circuit and to connect the tip strand through the contact 45 with a source of signaling current, and to connect the sleeve strand through contact 46 and the resistance 47 with the live pole of battery A.

The listening key 50 is adapted when actuated to connect the operator's receiver, the secondary of the induction coil and the condenser 53 in a bridge of the talking circuit. The impedance 52 is connected between the middle point of the receiver winding and ground. This operator's outfit is typical and it is to be understood that it may be substituted by any other form adapted for use with this circuit.

In operation, the subscriber in charge of substation number 1, desiring a conversational connection with the subscriber in charge of substation number 1′, removes his receiver 5 from the hook-switch 6, thereby completing a circuit from the live pole of battery A through the coil of the line relay 13, contacts 12 and 9 of the cut-off relay 11, line conductor 7, transmitter 4, receiver 5, hook-switch 6, conductor 8 and springs 10 and 14 of relay 11 to ground. Current in this path actuates the relay 13 closing its contacts 18 and thereby completing the circuit through the line signal 19. The operator seeing the signal 19 displayed, inserts her answering plug in the jack 16 and thereby completes a circuit from the live pole of battery A, through contacts 27 and 28 of relay 25, the coil of relay 29, sleeve of the plug and jack, and the coil of cut-off relay 11 to ground. Current in this path energizes the cut-off relay 11, attracting its armatures 9 and 10 to disconnect the line relay 13, and to connect the limbs of the telephone line directly with the tip and sleeve contacts of the line jack 16. Upon the actuation of the cut-off relay a new circuit will be immediately completed from the sleeve of the line jack, through contacts 15 and 9 of the relay 11 over the limbs of the telephone line, through contacts 10 and 17 of relay 11, the tip of the jack and plug and through the coil of relay 25 to the ground pole of battery. Current in this path immediately energizes the relay 25 which attracts its armature 27 to close the circuit from the live pole of battery through contacts 27 and 30 and the impedance coil 31. The movement of armature 27 severs the circuit through the contact 28 and the coil of relay 29, thereby allowing that relay to fall back and open its contacts 32 and 33 in the circuit of the signal 34. The momentary actuation of relay 29 will not be of sufficient duration to display the signal 34, if indeed the relay 29 is maintained in circuit long enough to actuate at all.

The operator now inquires the desired number and finding it to be that of substation 1′ connects the tip of her calling plug with the sleeve of one of the multiple jacks 16′ in order to obtain the idle or busy condition of the desired line. If the desired line is busy the sleeve contact will be at a potential higher than that of the ground pole of battery and current will flow from the sleeve contact over the tip of the cord circuit, through the contact 49 of the operator's listening key 50, the winding 51 of the operator's induction coil, a part of the operator's receiver and the winding of the impedance coil 52 to ground. Current in this path will cause a click in the operator's receiver, notifying the operator that the desired line is busy. Supposing, however, the desired line to have been found idle, the operator inserts her calling plug in the tested jack and throws her ringing key 24. The circuit is thereby completed from the live pole of battery through the resistance 47, contacts 46 of the listening key 24, the sleeve of the plug and jack and the coil of cut-off relay 11′. This energizes relay 11′ and causes its armatures 9′ and 10′ to be brought into contact with the inside contacts 15′ and 17′. A path for ringing current is now completed through the contact 45 of the ringing key 24, the tip of the plug and jack, contacts 17′ and 10′ of cut-off relay 11′, line conductor 8′, condenser 2′ and annunciator 3′, line conductor 7′, contacts 9′ and 15′ of relay 11′, sleeve of the jack and plug, contacts 46 of ringing key 24, through the resistance 47 and battery A to earth. When the ringing key is released a circuit is completed from the live pole of battery A, through the contacts 35 and 36 of relay 26, the coil of relay 37, the sleeve strand of the cord circuit, the sleeve of the plug and jack and the coil of relay 11′ to ground. This actuates relay 11′ as before stated, and also energizes relay 37, which attracts its armature 40, making connection with contact 41 and completing the circuit of the supervisory signal 42, thus displaying that signal.

When the called subscriber answers his call a circuit is completed from the sleeve of the jack through the contacts 15′ and 9′ of cut-off relay 11′ over the limbs of the telephone line, through contacts 10′ and 17′ of relay 11′, the tip of the jack and plug and the coil of relay 26 to the ground pole of battery A. This actuates relay 26, severing its contacts 35 and 36 in the circuit of relay 37 and connecting its contact 35 with its normally open contact 38, thus substituting the impedance coil 39 for the coil of relay 37. Relay 37 is thereby deënergized and its armature released to open the circuit

of supervisory signal 42, and thereby efface that signal. When the subscribers have terminated their conversation and replaced their receivers upon the hook switches the circuit through the coils of relays 25 and 26 is again severed, such relays falling back to again restore the coils of relays 29 and 37 into the local circuit through the cut-off relays. The actuation of relays 29 and 37 displays the supervisory signals and the operator removes her connections, whereby the apparatus is all restored to its normal condition.

In this system relays 11 and 11′ may be of high resistance, fifteen-hundred ohms giving satisfactory results, and relays 29 and 37 may be of a comparatively high resistance, five-hundred ohms being preferable. Thus, the leakage of voice currents will be very small through the windings of relays 11 and 11′ during conversation, but at the same time relays 29 and 37 will be sufficiently energized not to need a delicate adjustment.

While my invention is here shown and described with respect to certain details, it is to be understood that I do not wish to be unduly limited thereto, certain variations being possible without in any way departing from the spirit or scope of my invention.

What I claim is:

1. In a telephone system, the combination with a pair of telephone lines, of a cord circuit to connect said lines for conversation, a pair of relays and a source of current normally in a bridge of said cord circuit, the circuit of one of said relays being completed over a portion of the talking circuit and a third conductor when the cord is connected with a line, the circuit of the other of said relays being completed over the telephone line when the subscriber's instrument is in use, the actuation of the second relay being adapted to sever the circuit of the first relay, whereby said first relay becomes inoperative, and a supervisory signal controlled by said first relay, substantially as described.

2. The combination with a telephone line, of a source of electricity and a pair of relays adapted to be bridged between the limbs thereof at the central office, a switch at the substation and a switch at the central station for controlling the circuits through said relays, the switch at the central station being adapted to complete the circuit of one of said relays, and the switch at the substation being adapted to complete the circuit of the other of said relays, said latter relay also being adapted when actuated to open the circuit of the former relay, and a signal controlled by the former relay, substantially as described.

3. The combination with a metallic telephone line, of an operator's plug and cord, a source of current and a pair of relays bridged across said circuit, a third conductor connected with one pole of said source, one of said relays being operated over a part of the talking circuit and said third conductor when the subscriber's telephone is not in use, and the other of said relays being adapted to be operated over the metallic line when the subscriber's telephone is in use, said latter relay controlling contacts in the circuit of said former relay, whereby when the latter relay is energized the former is deënergized, and a supervisory signal controlled by the condition of the former relay, substantially as described.

4. In a telephone system, the combination with a telephone line, of a relay and a source of current bridged between the two limbs of the talking circuit thereof, a second relay at the central office connected in a circuit including a portion of the talking circuit when the subscriber's telephone is not in use, a switch at the substation for controlling the circuit of the first relay, said relay being adapted when actuated to open the circuit of the second relay, and a signal controlled by said second relay, substantially as described.

5. In a telephone system, the combination with a telephone line, of a cord circuit to connect with said line for conversation, a source of current, and a pair of relays normally bridged across said cord circuit, a supervisory signal, the actuation of one of said relays being adapted to display said supervisory signal, an impedance coil, the actuation of the other of said relays being adapted to substitute said impedance coil for the winding of the supervisory relay, whereby said relay is deënergized and the signal effaced, substantially as described.

6. In a telephone system, the combination with a telephone line, of a high resistance cut-off relay permanently bridged between one of the talking strands thereof, and a third conductor, a cord circuit, a source of current and a high resistance supervisory relay normally connected between said third conductor and a talking strand of said cord circuit, a switch at the central office adapted to complete the circuit of said source, said supervisory relay and said cut-off relay when the cord is connected with the line, an impedance coil connected in a normally open bridge around the coil of said supervisory relay, means for severing the circuit of said supervisory relay, and completing the circuit of said impedance coil when the telephone line is closed at the substation, and a signal controlled by said supervisory relay, substantially as described.

7. In a telephone system the combination with a telephone line, of a cord circuit to connect with said line for conversation, a

supervisory relay and a source of current normally in a bridge of said cord circuit, a pair of switches at the central office in series with said relay and said source, one of said switches being under the control of the operator and being adapted when closed to complete the circuit of said relay and the other of said switches being under the control of the subscriber and being adapted when operated to open the circuit of said relay and a signal controlled by the actuation of said relay.

8. In a telephone system, the combination with a telephone line, of a cut-off relay associated with the line connected between one of the limbs thereof and a third conductor, a cord circuit, a source of current and a supervisory relay connected between said third conductor and one of the limbs of said cord circuit, a switch at the central office under the control of the operator adapted to complete the circuit of said relays, an impedance coil at the central office, a switch at the central office under the control of the subscriber adapted when actuated to open the circuit of said supervisory relay, and to substitute the winding of said impedance coil therefor, whereby the supervisory relay becomes inoperative, and whereby the circuit of the cut-off relay remains intact, substantially as described.

9. In a telephone system, the combination with a telephone line, of a cord circuit to connect with the line for conversation, a supervisory relay for said cord circuit, a supervisory signal controlled thereby, a pair of switches at the central office, one under the control of the operator and the other under the control of the subscriber, an impedance coil in a normally open circuit, said latter switch being adapted by its actuation to place said impedance coil in the path of current supply from said source to said line and to deprive said supervisory relay of operating current, substantially as described.

10. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith for conversation, a central source of current, a tip supervisory relay connected between one strand of the cord circuit and said source, and a sleeve supervisory relay normally connected between the other strand of said cord circuit and said source, an impedance coil in a normally open bridge between the sleeve strand of said cord circuit and said source, the circuit of said sleeve supervisory relay containing normally closed contacts of said tip supervisory relay and the circuit of said impedance coil containing the normally open contacts of said tip supervisory relay, a signal displayed by the actuation of said sleeve supervisory relay, the circuit of the sleeve supervisory relay being completed when the cord is connected with a line open at the substation to display the supervisory signal, the circuit of the tip supervisory relay being completed when the line is closed at the substation, whereby the circuit of the sleeve supervisory relay is opened and the circuit of said impedance coil is completed, substantially as described.

11. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith for conversation, a relay for the line, and a relay for the cord, each connecting between a talking strand and a third conductor, a source of current in said third conductor, a switch under the control of the operator for connecting said relays in series with one another, each of said relays being of high resistance, the relay for the line being adapted to stop the passage of voice currents, and the relay for the cord being adapted to be strongly energized when connected in series with the relay for the line, and means to substitute a low resistance impedance coil in place of the cord relay when the telephone line is closed at the substation, whereby the cord relay will be deënergized, and whereby sufficient current to operate the substation transmitter will be furnished to the telephone line, and a supervisory signal controlled by said cord relay, substantially as described.

12. In a telephone system, the combination with a telephone line, of a cord circuit to connect with the line for conversation, a pair of supervisory relays and a source of current normally in a bridge between the talking conductors of the cord circuit, and an impedance coil in a normally open circuit adapted to be substituted for one of the relays in said bridge by the actuation of the other relay, substantially as described.

13. In a telephone system, the combination with a telephone line, of a cord circuit to connect with the line for conversation, a pair of relays normally in a bridge of said talking circuit, an impedance coil in a normally open circuit, one of said relays being adapted by its actuation to include said impedance coil in said bridge and to exclude the coil of the other relay from the bridge, 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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