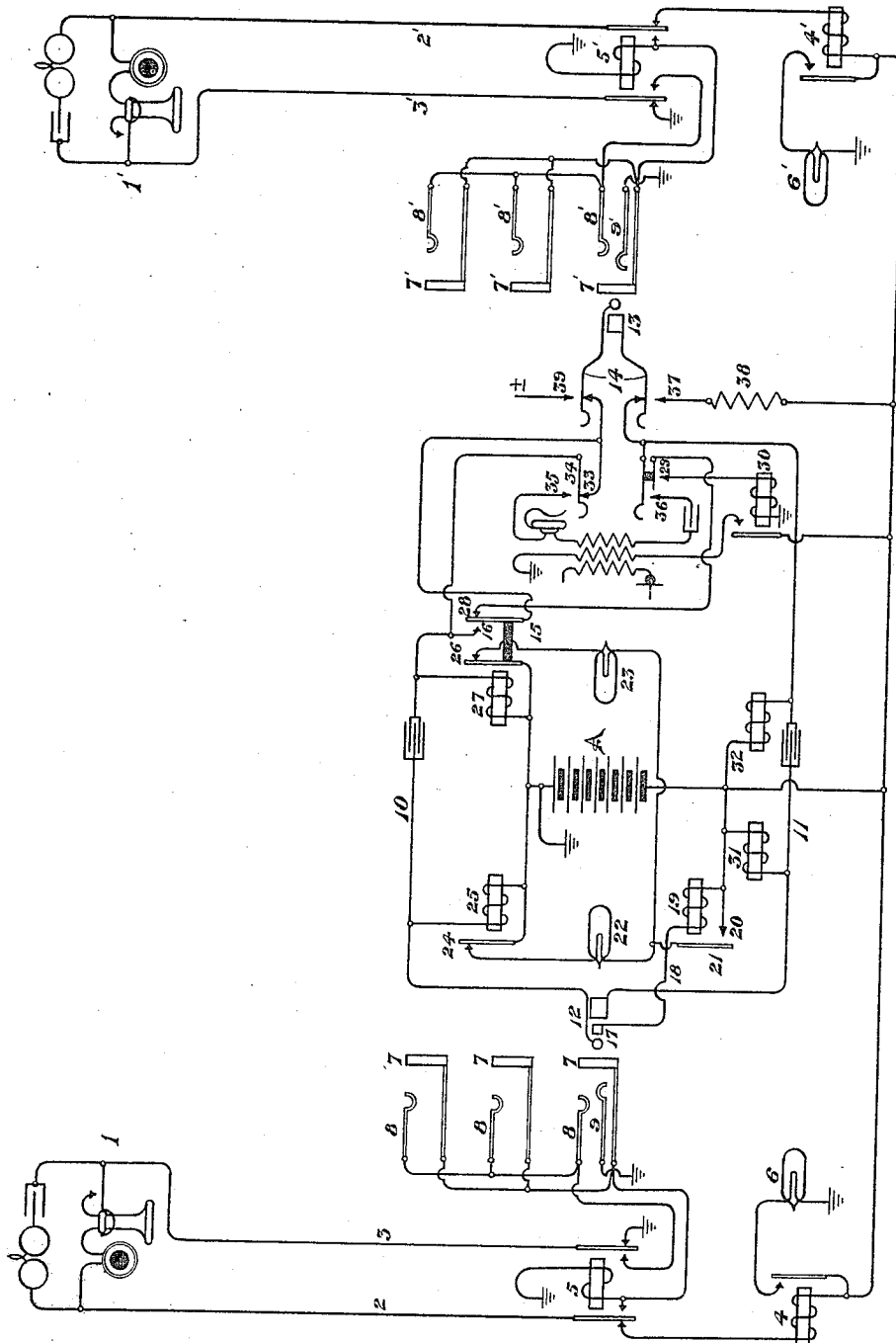


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TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

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Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, CLIFFORD C. BRADBURY, 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 particularly to the means at the central office for controlling the cord signals for keeping the operator informed of the condition of the telephone lines connected for conversation.

My invention relates to that class of circuit arrangements in which the cut-off relay for the line is bridged between one of the talking strands of the line and a third conductor. In this class of systems it has been customary in the past to use a cut-off relay of sufficiently low resistance that one of the supervisory relays of the cord circuit may be actuated in series with this cut-off relay when the cord circuit is connected with the line.

It is the object of my present invention to provide a system in which the supervisory relay of the cord circuit does not actuate in series with this cut-off relay. By this arrangement the cut-off relay may be wound to several thousand ohms resistance, and thereby effectually prevent all leakage of voice currents which tend during conversation to unbalance the talking conditions of the line.

A further object of my invention is to provide a system which will operate as above described, but which will have only two conductors extending through the multiple jacks.

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

The subscriber's station 1, here shown equipped with the usual telephone apparatus well known in the art, is connected to the central office by means of line conductors 2 and 3, line conductor 2 being connected to the live pole of battery A through normally closed contacts of the cut-off relay 5, and the coil of line relay 4, and line conductor 3 being connected with the ground terminal of battery A through normally closed contacts of the cut-off relay 5. One terminal of the coil of relay 5 is connected

with earth and the other terminal is connected with one of its own open contacts and with the sleeve contacts 7 of the answering and multiple jacks. The tip contacts 8 of the line and multiple jacks connect with the other open contact of relay 5, this contact being connected with line conductor 3 when the relay is actuated. The circuit of line signal 6 is controlled by contacts of line relay 4, the actuation of this relay being adapted to display the line signal. In addition to the tip and sleeve contacts the answering jack is provided with the ring contact 9 which is directly connected to the ground terminal of battery A. The telephone line at the right of the drawing is similarly equipped, the like apparatus being indicated by like numerals with the suffix "'." The cord circuit for connecting these lines for conversation is provided with the tip and sleeve talking strands 10 and 11 extending between the answering plug 12 and the calling plug 13. The answering end of each of these strands is separated from the calling end by condensers in the manner well known in the art, and each strand contains normally closed series contacts in the operator's ringing key 14. In addition to these contacts the tip strand contains normally open contacts 15 and 16 controlled by the tip calling supervisory relay and adapted to be closed when two lines are connected for conversation.

In addition to the usual tip and sleeve contacts, the answering plug is provided with a ring contact 17 adapted to register with ring contact 9 when the plug is inserted in the answering jack. This ring contact 17 is connected through conductor 18 and the coil of supervisory relay 19 with the live pole of battery A. The relay 19 controls normally open contacts 20 and 21 adapted by their actuation to complete the circuit of both supervisory signals 22 and 23. The circuit of supervisory signal 22 contains normally closed contacts 24 of tip answering relay 25, the coil of this relay being connected between the answering end of tip cord strand and the ground pole of battery A, and the circuit of supervisory signal 23 contains normally closed contacts 26 of tip relay 27, the coil of this relay being connected between the calling end of the tip strand of the cord circuit and the ground pole of battery A.

The supervisory relay 27 controls contacts 15 and 28 which normally connect the tip of the calling plug with the normally open auxiliary contacts 29 of the operator's listening key, these contacts being adapted when closed to complete the circuit of the testing strand through the coil of the test relay 30. In order to furnish a path for transmitter energization current the impedance coils 31 and 32 are connected between the live pole of battery A and the answering and calling ends respectively of the sleeve cord strand. The operator's listening key is provided with normally closed series contacts 33 and 34, contact 33 being connected with the tip of the calling plug, and contact 34 being connected with the tip strand of the cord circuit back of the point at which the tip strand is severed by normally open contacts 15 and 16. The listening key is also provided as usual, with contacts 35 and 36 adapted to be engaged by the tip and sleeve springs of the listening key to bridge the usual receiver, condenser and the secondary of the operator's induction coil across the talking circuit. Test relay 30 controls normally open contacts adapted when closed to complete a circuit from the live pole of battery A through said contacts, and through the tertiary winding in the operator's induction coil to earth. The operator's ringing key 14 is provided with the contact 37 which connects through the non-inductive resistance 38 with the live pole of battery A, this contact being adapted to make connection with the sleeve of the calling plug when the ringing key 14 is actuated. The generator contact 39 is adapted to be engaged by the top spring of the ringing key to impress the desired ringing current onto the tip limb of the line.

The operation of the system just described is as follows: Subscriber No. 1 removes his receiver from the hook, and thereby completes a circuit from the live pole of battery A through the coil of line relay 4, normally closed contacts of the cut-off relay 5, line conductors 2 and 3, and the other normally closed contacts of relay 5 to earth. Current in this path actuates the line relay 4, completing the circuit of the line signal 6. The operator, observing the line signal, inserts her answering plug in the jack indicated by the signal 6, and thereby completes a circuit from the live pole of battery A through the impedance coil 31, the sleeve strand 11 of the cord circuit, the sleeve conductor 7 of the answering jack and the coil of cut-off relay 5 to earth. Current in this path actuates cut-off relay 5 which severs the circuit of the line relay 4 effacing signal 6 and connects line conductors 2 and 3 respectively with the jack conductors 7 and 8. The insertion of the answering plug also completes a circuit from the live pole of battery

A through the coil of relay 19, over conductor 18, ring contacts 17 and 9 of the answering plug and jack to earth. Current in this path actuates relay 19 completing the circuit of supervisory signal 23 from battery through the contacts 20 and 21 of relay 19 and contacts 26 of relay 27 to earth. The circuit of signal 22 is now maintained open at contacts 24 of relay 25, the circuit of relay 25 now being completed from the live pole of battery A through impedance coil 31, the sleeve of the answering plug and jack, the now closed contacts of cut-off relay 5, line conductors 2 and 3, the other closed contacts of cut-off relay 5, tip contacts of the answering jack and plug, and the coil of relay 25 to earth. The operator now throws her listening key and asks the desired number of the calling party. Finding the desired line to be that leading to substation 1', the operator touches the tip of her calling plug to the test conductor of the multiple jack to obtain the idle or busy condition of the line. If the line is busy the sleeve of this jack will be at a potential higher than that of ground, and current will flow from the sleeve of the jack over the tip strand of the cord circuit, through contacts 15 and 28 of relay 27, the now closed auxiliary contacts 29 on the operator's listening key, and through the coil of the test relay 30. Current in this path will actuate the test relay and thereby complete a circuit through the tertiary winding of the operator's induction coil, causing a click in the operator's receiver. Assuming that the desired line is found idle, the operator inserts her calling plug 13 into one of the multiple jacks and actuates her ringing key 14. The actuation of this key completes a path from the live pole of battery A through resistance 38, contacts 37 of the ringing key 14, the sleeve of the calling plug and the jack and through the coil of the cut-off relay 5' to ground. Current in this path actuates relay 5' and connects line conductors 2' and 3', respectively with the sleeve and tip jack contacts 7' and 8'. The tip spring of the ringing key 14 connects with the generator contact 39, thereby completing the signaling circuit over the line conductors and through the substation condenser and annunciator. When the ringing key is released a new path for current is completed thereby from the live pole of battery A through the impedance coil 32, the sleeve strand of the cord circuit, the sleeve of the calling plug and jack and the coil of cut-off relay 5'. Current in this path maintains the actuation of cut-off relay 5' which maintains the line conductors 2' and 3', connected respectively with the sleeve and tip strands of the multiple jacks. When the desired subscriber answers his call a path for current is com-

pleted from battery through the impedance coil 32, sleeve of the calling plug and jack, line conductor 2', the substation hook switch, line conductor 3', the tip of the jack and plug, contacts 33 and 34 of the operator's listening key and the coil of relay 27 to the ground pole of battery. Current in this path actuates the relay 27, thereby severing the circuit of the supervisory signal 23, and also severing the contacts 15 and 28, and completing the normally open contacts 15 and 16. It will be seen that the operator may now actuate her listening key while the conversation is in progress without interrupting the conversation, the circuit of relay 27 being now completed through its own contacts 15 and 16, such that when contacts 33 and 34 of the operator's listening key are severed current will continue to flow through the branch conductor containing contacts 15 and 16 of the tip relay 27. When either of the subscribers hangs up his receiver the supervisory signal associated with his end of the cord circuit is again displayed and when both of said signals are displayed the operator removes the plugs from their connections with the line jacks and the apparatus again assumes its normal condition.

I have thus described my invention with respect to the accompanying illustration, but it is to be understood that I do not wish to be unduly limited thereto, certain modifications and substitutions being quite 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 telephone line, of a cut-off relay associated therewith, a cord circuit to connect with the line for conversation, a supervisory relay actuated over a circuit independent of the talking circuit and of the coil of the cut-off relay when the cord is connected to said line, a second supervisory relay, and means to energize it, and a signal controlled by the conjoint action of said relays, substantially as described.

2. In a telephone system, the combination with a telephone line, of a pair of contacts at the central office in the talking circuit of the line, a cut-off relay connected with one of said contacts, a third contact for the line connected with a conductor independent of the talking circuit, a cord circuit having a pair of talking contacts, and a third contact adapted to register with the contacts of the line, a source of current, a supervisory relay connected between said source and said third contact of the cord circuit adapted to be actuated when the cord is connected with the line, a second supervisory relay under the control of the subscriber, and a supervisory signal controlled by said relay, substantially as described.

3. In a telephone system, the combination with a telephone line, of a cut-off relay for the line connected with one of the talking strands thereof during conversation, a cord circuit, a central source of current, a relay and an impedance coil bridged between the talking strands of the cord circuit, said cut-off relay and said impedance coil being connected in a local circuit with said source when the cord is connected with the line, a second relay for the cord circuit having its circuit completed over a different path when the cord is connected with the line, and a supervisory signal controlled by the conjoint action of said cord relays, substantially as described.

4. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a relay, a source of current and an impedance coil bridged across the cord circuit, a cut-off relay having its coil connected with a limb of the line, said cut-off relay being actuated by current through said impedance coil when the cord is connected with the line, a second relay for the cord circuit actuated over a local circuit independent of the talking circuit when the cord is connected with the line, and a supervisory signal controlled by the conjoint action of said cord relays, substantially as described.

5. The combination with a telephone line, of a source of electricity, a relay and an impedance coil bridged between the limbs of the talking circuit thereof, a second relay in a local circuit including said source and said impedance coil, a third relay in a local circuit independent of the talking circuit, a switch at the substation for controlling the circuit of the first relay, and switches at the central station for controlling the circuits of said second and third relays, and a supervisory signal controlled by the conjoint action of the first and third relays, substantially as described.

6. The combination with a telephone line, of a charging current source, a third conductor, three relays at the central office, one of said relays being energized over the telephone line, another over a portion of the talking circuit and the third conductor, and the third over a circuit independent of operative association with the talking circuit, and a signal controlled by said first and third relays, substantially as described.

7. The combination with a telephone line, of a charging source of current, a third conductor, three relays at the central office, one of said relays energized over the telephone line, another over a portion of the talking circuit and the third conductor, and the third over a circuit independent of the talking circuit and including said third conductor, substantially as described.

8. The combination with a telephone line, 130

- of a cord circuit adapted to be connected therewith, a charging current source, a relay associated with the line, two relays associated with the cord circuit, the relay associated with the line being actuated over a local circuit including a portion of the talking circuit, one of said cord relays being actuated over the telephone line, and the other of said cord relays being actuated during the connection of the cord with the line over a local circuit independent of the talking circuit, and a supervisory signal controlled by the conjoint action of said cord relays, substantially as described.
9. The combination with a telephone line, of a cord circuit to connect therewith, a charging current source, a third conductor, a cut-off relay for the line, a pair of supervisory relays for the cord circuit, the cut-off relay being energized over a local circuit including a portion of the talking circuit and said third conductor, one of said supervisory relays being actuated over the telephone line, and the other of said supervisory relays being controlled over a local circuit independent of operative association with the talking circuit, and a supervisory signal controlled by the conjoint action of said supervisory relays, substantially as described.
10. The combination with a telephone line, of a cord circuit to connect therewith for conversation, a charging current source, a third conductor, a cut-off relay for the line actuated over a portion of the talking circuit when the cord is connected with the line, a supervisory relay for the cord circuit energized over the telephone line when the cord is connected therewith and the line is closed at the substation, a second supervisory relay for the cord circuit energized over a local circuit independent of the talking circuit and including said third conductor when the cord is connected with the line, substantially as described.
11. The combination with a telephone line, of a cord circuit to connect therewith for conversation, answering and multiple jacks for the line, each having a pair of contacts in the talking circuit when the line is connected for use, a third conductor, a cut-off relay connected between one of said contacts and said third conductor, an additional contact for the answering jack connected with said third conductor and independent of the talking circuit, and a conductor associated with the cord circuit having a contact adapted to register with said additional contact of the answering jack when the answering plug is connected therewith, and a supervisory signal displayed by current in said cord conductor, substantially as described.
12. The combination with a telephone line having answering and multiple jacks at the central office, contacts of said jack connected with the talking strands of the telephone line when the line is in use, an additional contact in the answering jack independent of the talking circuit, a cord circuit having a plug with contacts adapted to register with the contacts of the answering jack, two of the contacts of said plug being in the talking circuit, the third contact being independent of the talking circuit, and being adapted to register with the additional contact of the answering jack, a supervisory relay for the cord circuit connected with said third contact of the plug, a pair of supervisory signals for the cord circuit, each having its circuit controlled at one point by contacts of said supervisory relay, two additional supervisory relays for the cord circuit, one under the control of the calling subscriber and the other under the control of the called subscriber when the cord is connected for use, the actuation of said latter relays respectively controlling the circuits of said supervisory signals at other points, substantially as described.
13. The combination with a telephone line having answering and multiple jacks at the central office, of a cord circuit for connecting therewith, a cut-off relay for the line, and a supervisory relay for the cord circuit, means for completing the circuit of the cut-off relay when the cord is connected with any of said jacks, and means for completing the circuit of the supervisory relay only when the cord is connected with the answering jack, substantially as described.
14. The combination with a pair of telephone lines having answering and multiple jacks at the central office, a cord circuit for connecting therewith, a cut-off relay associated with each of said lines, a supervisory relay associated with the answering end of the cord circuit, the circuit of said cut-off relays being completed when the cords are connected with any of the jacks of said lines, the circuit of said supervisory relay being completed only when the answering plug is connected with the answering jack of one of said lines, substantially as described.
15. The combination with a telephone line having two contact multiple jacks at the central office, an answering jack for the line having three contacts, two of which are permanently connected with the two contacts of the multiple jacks, the third contact of said answering jack being independent of the contacts of the multiple jacks, a cord circuit to connect with the line, a supervisory signal for the cord circuit displayed by current over said third contact of the answering jack when the answering end of the cord is connected therewith, substantially as described.
16. The combination with a telephone line

having two contact multiple jacks at the central office, an answering jack for the line having three contacts, two of which are permanently connected with the two contacts of the multiple jacks, the third contact of said answering jack being independent of the contacts of the multiple jacks, a cord circuit to connect with the line, a pair of supervisory signals displayed by current over said third contact of the answering jack when the cord is connected therewith, substantially as described.

17. The combination with a telephone line having two contact multiple jacks at the central office, an answering jack for the line having three contacts, two of which are permanently connected with the two contacts of the multiple jacks, the third contact of said answering jack being independent of the contacts of the multiple jacks, a cord circuit to connect with the line, a supervisory relay for the cord circuit actuated by current over said third contact of the answering jack when the cord is connected therewith, substantially as described.

18. The combination with a telephone line

having two contact multiple jacks at the central office, an answering jack for the line having three contacts, two of which are permanently connected with the two contacts of the multiple jacks, the third contact of said answering jack being independent of the contacts of the multiple jacks, a cord circuit to connect with the line, a supervisory relay for the cord circuit actuated by current over said third contact of the answering jack when the answering end of the cord is connected therewith, supervisory signals, one for each end of the cord circuit displayed by the actuation of said relay, said signals being respectively under the control of the calling and called subscribers when two lines are connected for use, substantially as described.

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

CLIFFORD C. BRADBURY.

Witnesses:

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