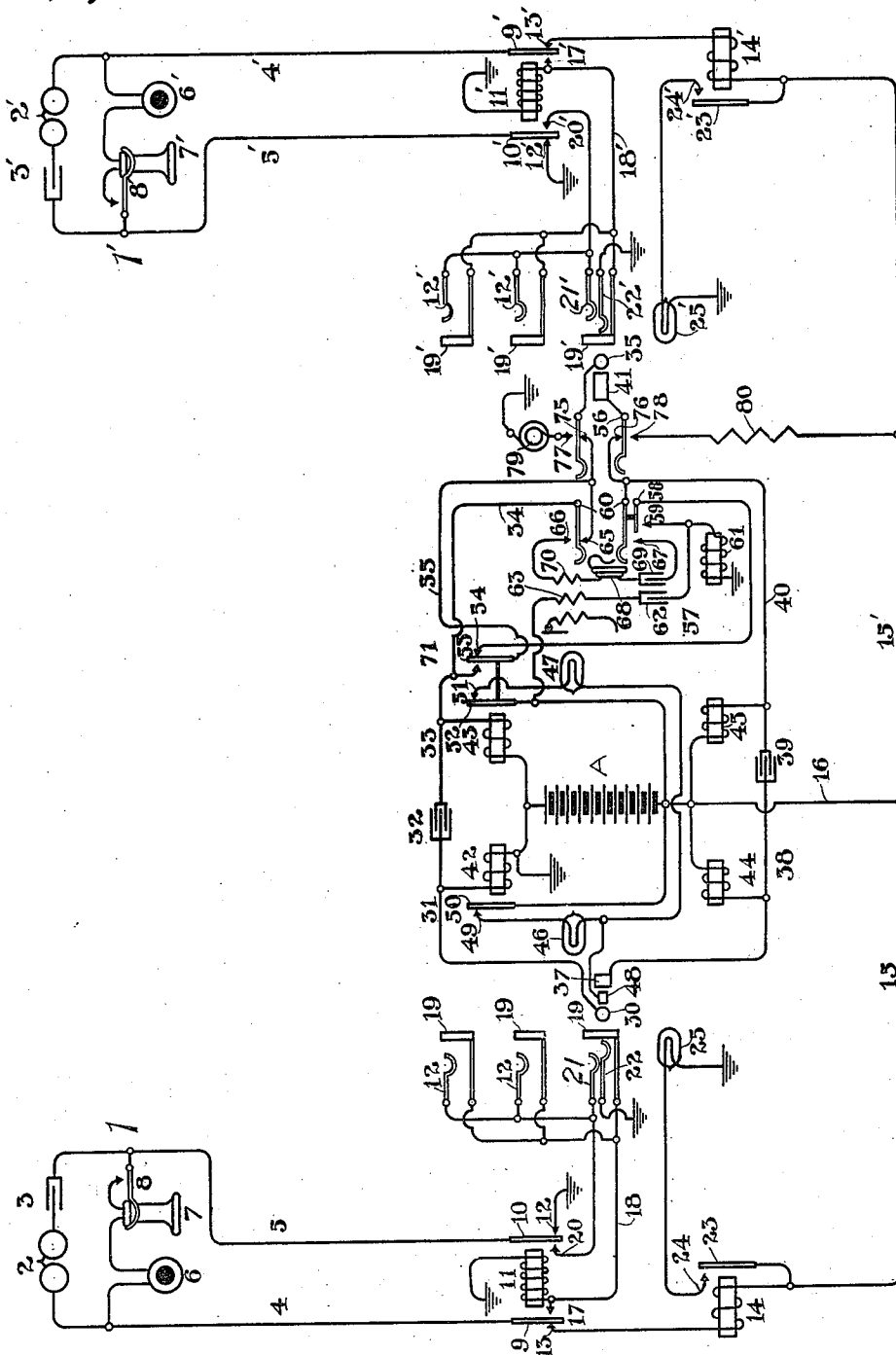


C. C. BRADBURY.
TELEPHONE SYSTEM.
APPLICATION FILED OCT. 16, 1907.

975,504.

Patented Nov. 15, 1910.



Witnesses
W. H. Hadley
Marjorie C. Grier

Clifford C. Bradbury
Inventor
By Curtis B. Camp
Attorney

UNITED STATES PATENT OFFICE.

CLIFFORD C. BRADBURY, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

975,504.

Specification of Letters Patent. Patented Nov. 15, 1910.

Application filed October 16, 1907. Serial No. 397,653.

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 of the central energy type.

The object of my invention is to simplify the signaling apparatus at the central office of the system, and at the same time, to produce a system positive in its operation and simple to manufacture and install.

In systems of the character here shown in which the cut-off relay is energized between one side of the talking circuit and a third conductor, it has been customary in the past to use a cut-off relay of sufficiently low resistance that a second relay associated with the cord circuit might be operated in series with the cut-off relay.

One object of the present invention is to produce a cord circuit having no relay which operates through the resistance of the cut-off relay, whereby the latter relay may be given a very high resistance so as to unbalance the line conditions as little as possible.

My invention is illustrated in the accompanying drawing in which the calling subscriber's station 1 is illustrated at the left and is equipped with the annunciator 2 and condenser 3 in a permanent bridge between the line conductors 4 and 5, and with the transmitter 6 and receiver 7 in a bridge between said conductors maintained normally open by contacts of the switch-hook 8.

At the central office the lines 4 and 5 terminate respectively in the springs 9 and 10 of cut-off relay 11, spring 10 being connected with earth through the normally closed contact 12 and spring 9 being connected through contact 13, the coil of line relay 14 and conductors 15 and 16 with the live pole of battery A. Relay 11 also has the normally open contact 17 connecting with the coil of that relay and also, through conductor 18, with the sleeve and test contacts 19 of the answering and multiple jacks. Relay 11 also has the normally open contact 20 which connects with the tip contacts 21 of the answering and multiple jacks. The answering jack is further provided with a ring contact 22 which is not carried through the multiple

and which is connected directly with the ground pole of battery A. Line relay 14 controls normally open contacts 23 and 24 in the circuit of line lamp 25.

The called subscriber's station and line illustrated at the right of the drawing is equipped with apparatus identical with the apparatus of the calling subscriber's station, corresponding apparatus being designated by like figures with the suffix "7."

The cord circuit for connecting the calling and called telephone lines is made up of the tip and sleeve talking strands, and the auxiliary circuits necessary for signaling purposes and for supplying transmitter energization current to the substation.

The tip contact 30 of the answering plug is connected through the conductor 31, condenser 32, and conductors 33 and 34 with the tip contact 35 of the calling plug. Similarly, sleeve contact 37 of the answering plug is connected through conductor 38, condenser 39 and conductor 40 with the sleeve contact 41 of the calling plug. The main battery A is connected in a bridge between the tip and sleeve strands of the cord circuits by the coils of relays 42 and 43 on the tip side, and the windings of impedance coils 44 and 45 on the sleeve side. The answering and calling ends of the cord circuit are equipped with the supervisory lamps 46 and 47, each of these lamps having a terminal connected to the ring contact 48 of the answering plug. The other terminals of these lamps are connected respectively through the contacts 49 and 50 of relay 42, and 51 and 52 of relay 43 with the live pole of battery A. Relay 43 has, in addition to its contacts in the circuit of the supervisory lamp 47, the normally closed contacts 53 and 54, the spring contact 53 being connected through conductor 55 and the normally made contacts of the operator's ringing key 56 with the tip of the calling plug. Contact 54 of relay 43 connects through conductor 57 with the contact 58 which is adapted to make connection with the point 59 when the operator's listening key 60 is actuated. The point 59 is connected through the impedance coil 61 with ground and also through the condenser 62 and tertiary winding 63 of the operator's induction coil with the live pole of battery A. The tip spring of the operator's listening key 60 normally makes contact with the point 65 and com-

pletes the circuit between the tip 35 and talking conductor 34. The actuation of the listening key 60, however, disconnects the contact 65 and connects the tip and sleeve springs of the listening key respectively with contacts 66 and 67, thus placing the operator's head receiver 68, condenser 69 and secondary 70 of the operator's induction coil in a bridge between the talking strands of the cord circuit. The spring 53 of relay 43 is adapted upon the actuation of the relay to make contact with the point 71, thus placing a shunt about the break between the tip spring of the operator's listening key 60 and the normally made contact 65. The operator's ringing key 56 has the normally made contacts 75 and 76 adapted to be broken by the actuation of the key, the tip and sleeve springs of the key respectively making contact with the points 77 and 78. The point 77 connects through the ringing generator 79 with earth, while the point 78 connects through the non-inductive resistance 80 and conductors 15' and 16 with the live pole of battery A.

In the operation of completing a connection between the calling and the called subscriber's stations, the subscriber in charge of substation No. 1 removes his receiver 7 from switch-hook 8 and thereby completes a circuit from the live pole of battery A through conductors 16 and 15, the coil of relay 14, contacts 13 and 9 of cut-off relay 11, line conductor 4, transmitter 6, receiver 7 and switch-hook 8, line conductor 5, and contacts 10 and 12 of cut-off relay 11 to ground. Current in this path actuates relay 14 closing its contacts 23 and 24 which thereby complete the circuit of line lamp 25 and display that signal to indicate to the operator that a connection is desired.

Upon observing the display of the signal 25 the operator inserts her answering plug into the answering jack of the indicated line, thereby completing the connections between the tip, ring and sleeve contacts of the plug and tip, ring and sleeve contacts of the answering jack. A circuit is thereby completed from the live pole of battery A through contacts 52 and 51 of relay 43, the signal 47 and the ring contacts 48 and 22 of the plug and jack to ground, thus displaying the signal 47. A circuit is also completed from the live pole of battery A through the impedance coil 44, the sleeve contacts 37 and 19 of the plug and jack, and conductor 18 and the coil of cut-off relay 11 to ground. Current in this latter path actuates relay 11 which thereby completes the circuit from its contact 17 through the spring 9, line conductor 4, transmitter 6, receiver 7, switch-hook 8, line conductor 5, contacts 10 and 20 of relay 11, tip contacts 21 and 30 of the jack and plug, conductor 31 and the coil of relay 42 to ground. This

actuates relay 42 and prevents the display of the signal 46 which would otherwise have been displayed upon the insertion of the answering plug into the answering jack. The operator now throws her listening key 60 which places her receiver 68 in a bridge between the talking conductors 34 and 40 and asks the desired number. Upon learning that the desired number is that of subscriber's station 1', the operator lifts her calling plug and touches her tip contact 35 with one of the multiple test contacts 19' of the desired line. If the desired line is busy one of the test contacts 19' will be in connection with the sleeve contact of another cord circuit and will therefore be maintained at a potential higher than that of ground. Current will therefore flow through the tip contact 35 through contact 75 of the operator's ringing key 56, over conductor 55, through contacts 53 and 54 of relay 43, over conductor 57, through the now closed auxiliary contacts 58 and 59 of the operator's listening key 60 and through the impedance coil 61 to ground. The flow of current in this path will slightly change the potential at one terminal of the condenser 62 and will therefore cause a partial discharge of that condenser which will in turn cause a disturbance in the tertiary winding 63 of the operator's induction coil, which will induce a similar disturbance in the secondary 70 and in the operator's receiver 69. Assuming, however, that the desired line is found to be idle and that no click is received by the operator, she now proceeds to insert her calling plug into one of the multiple jacks of the desired line and causes her tip contact 35 to register with the tip contact 21' of the jack and the sleeve contact 41 to register with the sleeve contact 19' of the multiple jack. The operator now throws her ringing key 56 and connects the tip spring with the contact 77 which connects through the generator 79 with earth and the sleeve spring with the contact 78, which connects through the non-inductive resistance 80 and conductors 15' and 16 with the live pole of battery A. Current therefore flows from the battery A through conductors 16 and 15', non-inductive resistance 80, contact 78 and the sleeve spring of the ringing key 56, the sleeve contacts 41 and 19' of the plug and jack, conductor 18' and the coil of relay 11' to ground. This actuates that relay and moves its contacts 9 and 10 to their abnormal positions in which they connect with the points 17' and 20'. As soon as the contact 20' connects with contact 10' a circuit is completed from the ringing generator 79 through contact 77 and the tip spring of the ringing key 56 over the tip contacts 35 and 21' of the plug and jack, contacts 20' and 10' of relay 11', line conductor 5', condenser 3', annunciator 2', line

conductor 4', contacts 9' and 17' of cut-off relay 11', conductor 18', sleeve contacts 19' and 41 of the jack and plug, the sleeve spring of ringing key 56, contact 78, non-inductive resistance 80 and through conductors 15' and 16 and the battery A to ground, and thence back to the generator 79. The alternating current in this path passes through condenser 3' and rings the annunciator bell 2', calling the desired subscriber to his phone. When the ringing key 56 is released a new circuit is completed from the live pole of battery A through the impedance coil 45, conductor 40, contact 76 and sleeve, the spring of ringing key 56, sleeve contacts 41 and 19' of the plug and jack, conductor 18' and the coil of relay 11' to earth, the current in which maintains the actuation of relay 11'.

When the called subscriber answers his call a new path for current is completed from the point 17' over line conductor 4', transmitter 6', receiver 7', switch-hook 8', line conductor 5', contacts 10' and 20' of cut-off relay 11', tip contacts 21' and 35 of the jack and plug, contact 75 of the ringing key, contact 65 of the listening key, conductors 34 and 33 and the coil of relay 43 to the ground pole of battery. Current in this path actuates relay 43 separating its contacts 51 and 52 and effacing the signal 47 to indicate to the operator that the called subscriber has responded to his call. The actuation of relay 43 also interrupts the connection between contacts 53 and 54 and completes the connection between contacts 71 and 53 which later contacts complete a shunt about the contact 65 and the tip spring of the operator's listening key 60. The completion of this shunt makes it possible for the operator to throw her listening key at any time during the conversation without severing the circuit of relay 43. The calling and called subscribers' lines are now in condition for conversation and all signals at the central office are effaced.

Upon the termination of the conversation, supposing subscriber No. 1 to be the first to replace his receiver, the circuit of supervisory relay 42 is severed at the contacts of the switch-hook 8. The deenergization of relay 42 causes its contacts to assume their normal position which closes the circuit of supervisory lamp 46 and displays that lamp. Similarly, when the called subscriber 1' replaces his receiver upon the hook the circuit of relay 43 is severed, thus causing its contacts to assume their normal positions and completing the connection between contacts 51 and 52 in the circuit of supervisory lamp 47. When both lamps 46 and 47 are displayed the operator removes the plugs from the jacks and thus again interrupts the circuit of signals 46 and 47 by breaking the connection between the ring contacts 48 and

22 of the answering plug and jack. The apparatus is now in its normal condition and ready for a second call.

While my invention is shown and described with respect to certain definite combinations, and while the apparatus is largely shown in a conventional form, it is to be understood that I do not wish to be unduly limited to these disclosures, many variations and substitutions being possible without in any way departing from the spirit or scope of my invention.

I claim:

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 pair of supervisory signals for the cord circuit adapted to be 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 plug and jack contacts included in said circuit, a pair of supervisory relays bridged across said cord circuit, each relay controlling contacts in the circuit of one of said supervisory signals, 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 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 jack, a source of current, a pair of supervisory signals normally connected between said source and said third contact of the cord circuit adapted to be displayed when the cord is connected with an idle line, a pair of supervisory relays under the control of the subscribers, each controlling the circuit of one of said supervisory signals, substantially as described.

3. In a telephone system, the combination with calling and called telephone lines, of a cord circuit adapted to connect them for conversation, answering and calling supervisory signals for the cord circuit, the circuit of said signals being completed over a path independent of the talking circuit and including contacts of the answering plug and jack when the answering plug is connected with the answering jack, the circuit of one of said signals being also under the control of the calling subscriber and the circuit of the other signal being also under the control of the answering subscriber, substantially as described.

4. In a telephone system, the combination with a telephone line having two talking contacts at the central office, a third contact independent of the talking contacts, a cord circuit having talking contacts to register with the talking contacts of the line,

and a third contact to register with the third contact of the jack, a source of current, a pair of supervisory signals in the circuit of said third contact and said source, and means
5 under the control of the subscribers for interrupting the circuits of said signals during a complete connection, substantially as described.

5. In a telephone system, the combination
10 with a telephone line, of a cut-off relay for the line, a cord circuit adapted to be connected with the line, a supervisory signal in a circuit associated with the cord circuit, a manually operated switch at the central
15 office having contacts closed by the connection of said cord with said line, contacts of said switch being independent of connection with the talking circuit and of the coil of said cut-off relay, a second switch in the
20 circuit of said supervisory signal permanently associated with the cord circuit and under the control of the subscriber when the cord is connected with the line, substantially as described.

6. In a telephone system, the combination
25 with a telephone line, of a cut-off relay for the line actuated over part of the talking circuit, a cord circuit, a jack for the line and a plug for the cord circuit, a supervisory
30 signal for the cord circuit having its circuit completed through contacts of the plug and jack independent of the talking circuit, and a relay for the cord circuit under the control of the subscriber for controlling
35 the circuit of said signal at another point, substantially as described.

7. In a telephone system, the combination
40 with a telephone line having answering jacks, of a cord circuit having an answering plug, a pair of signals for the cord circuit, each of said signals having a terminal connected with a contact of the answering plug independent of the talking contacts, a pair of supervisory relays for the cord circuit
45 respectively controlling contacts in the circuits of each of said signals, said relays being under the control of the subscribers during a connection, substantially as described.

8. In a telephone system, the combination
50 with a telephone line, of a cord circuit to connect therewith, a source of current, a cut-off relay for the line, and means to complete the circuit of said cut-off relay when the cord is connected with the line, a supervisory
55 signal for the cord circuit, means to complete the circuit of said signal and said source when the cord is connected with the line over a path independent of connection with the talking circuit and of the coil of said cut-off relay plug and jack contacts included in said circuit, and means permanently associated with the cord circuit and actuated over the talking circuit of the telephone line for again interrupting the
60 circuit of said signal, substantially as described.

9. In a telephone system, the combination
with a telephone line having two contact multiple jacks and three contact answering
jacks at the central office, the two contacts of the multiple jacks being multiply connected with two of the contacts of the answering jack, the third contact of the answering jack being connected with a third
70 conductor independent of the other two contacts of the jack, a cord circuit to connect with the line for conversation, the answering plug of said cord circuit having three contacts, answering and calling supervisory signals connected with one of the contacts of said plug and adapted to be actuated by
75 current from the third contact of the answering jack and said third conductor when the plug is inserted in the answering jack, and a pair of relays, one associated with each end of the cord circuit, said relays also
80 controlling the circuits of said answering and calling supervisory signals, substantially as described.

10. In a telephone system, the combination
with a telephone line having answering
85 and multiple jacks at the central office, a pair of contacts in the talking circuit in each of said jacks, and an auxiliary contact in the answering jack independent of the talking circuit, a cut-off relay for the line
90 bridged between one limb of the talking circuit and a third conductor, a cord circuit having an answering plug, a pair of talking contacts for said plug, an auxiliary contact for said plug to register with the auxiliary
95 contact of the answering jack and independent of the talking circuit, a pair of signals for the cord circuit, each having a terminal connected with said auxiliary contact and each having the other terminal connected
100 with a pole of said source, and means for independently interrupting the circuits of said signals at points between the signals and said source, substantially as described.

11. In a telephone system, the combination
110 with a telephone line having answering and multiple jacks at the central office, a pair of contacts in the talking circuit in each of said jacks, and an auxiliary contact in the answering jack independent of the talking
115 circuit, a cut-off relay for the line bridged between one limb of the talking circuit and a third conductor, a cord circuit having an answering plug, a pair of talking contacts for said plug, an auxiliary contact for said plug
120 to register with the auxiliary contact of the answering jack and independent of the talking circuit, a pair of signals each adapted to have its circuit completed over said auxiliary contact of the plug and said auxiliary
125 contact of the jack, and means to independently interrupt the circuits of said signals at another point, substantially as described.

12. In a telephone system, the combination
with a telephone line, of a cord circuit
130

to connect therewith, a pair of supervisory signals for the cord circuit, each having its circuit completed through contacts of the answering plug and jack, and means for
5 independently interrupting the circuit of said signals, substantially as described.

13. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, an answering and a
10 calling supervisory signal for the cord circuit, each having its circuit completed through the contacts of the answering plug and jack, substantially as described.

14. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a pair of supervisory
15 signals for the cord circuit, each having its circuit completed through contacts of the answering plug and jack, and a pair of
20 supervisory relays for independently inter-

rupting the circuits of said signals, substantially as described.

15. In a telephone system, the combination with a telephone line, of a cord circuit to connect therewith, a pair of supervisory
25 signals for the cord circuit each having its circuit completed through contacts of the answering plug and jack, and a pair of supervisory relays, one under the control
30 of the calling subscriber and the other under the control of the called subscriber for independently interrupting the circuits of said signals, substantially as described.

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

CLIFFORD C. BRADBURY.

Witnesses:

MARJORIE E. GRIER,
EDITH F. GRIER.