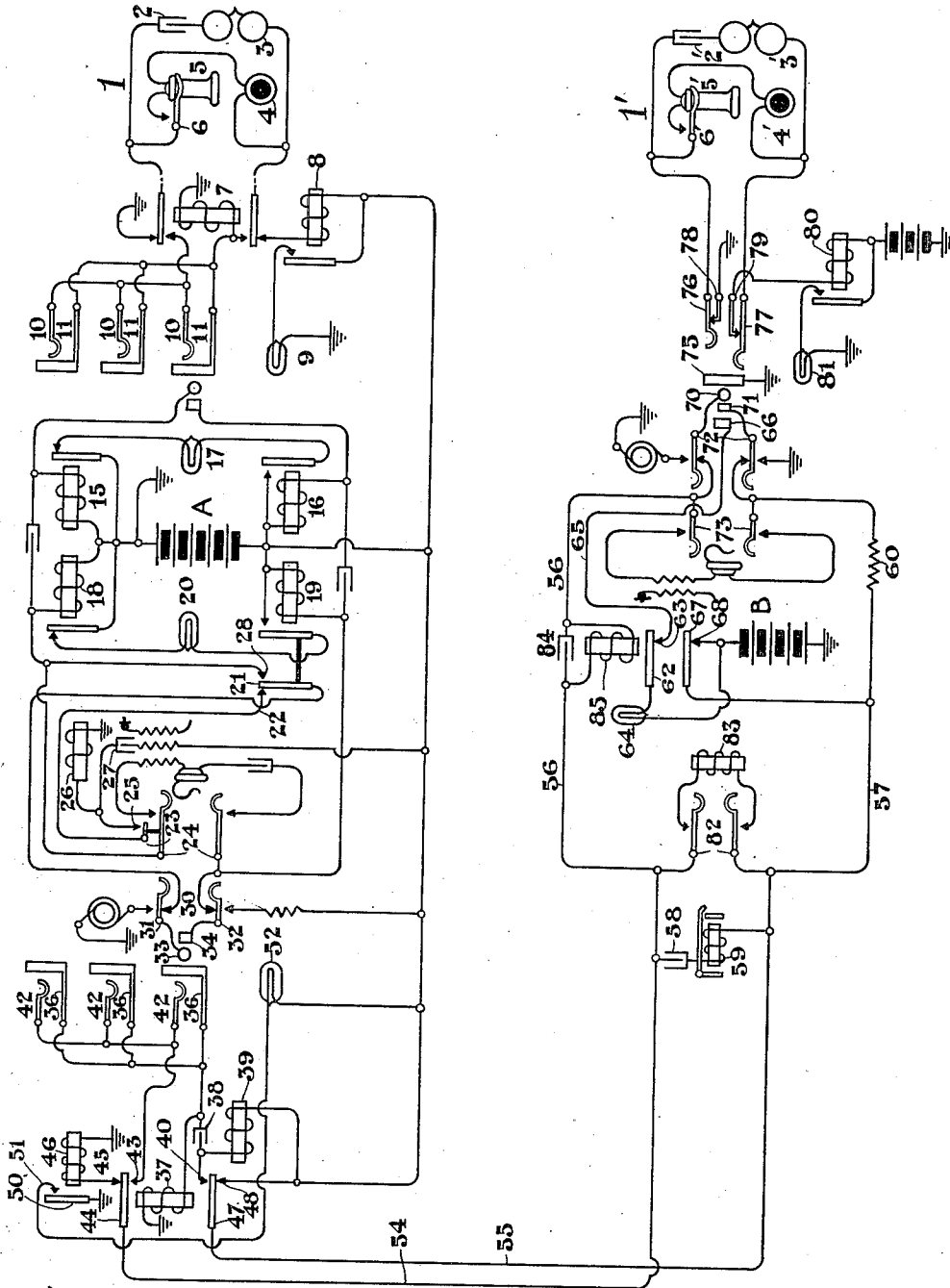


C. A. SIMPSON.
TELEPHONE TRUNKING SYSTEM.
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Patented Nov. 21, 1911.



Witnesses
D. C. Hadley
C. C. Bradbury

Charles A. Simpson
Inventor
By Curtis B. Camp
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES A. SIMPSON, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

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Specification of Letters Patent.

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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 Trunking Systems, of which the following is a specification.

My invention relates to telephone systems, and particularly to means for charging the storage battery of a private branch exchange over a two-wire trunk circuit whenever the trunk is not in use for conversational purposes.

It has been customary in the past to have a separate wire running from the main exchange to the branch exchange for the purpose of charging the storage battery at the branch exchange, or else to make special connections with each end of the trunk line for charging purposes. With the system of my present invention the storage battery at the branch exchange may be of very low amperage because it will be charged over all of the trunk circuits at all times that these trunk circuits are not in use.

My invention is illustrated in the accompanying drawing, in which a cord circuit of the type used at the main exchange is shown at the top, and a trunk and connecting circuit of the type used at the branch exchange is shown at the bottom of the sheet.

It is to be understood that any form of cord circuit may be used at the main exchange and that many details of the trunk circuit at the branch exchange may be changed without departing from the spirit or scope of my invention.

The subscriber's station 1 has the usual condenser 2 and annunciator 3 connected in a bridge between the limbs of the telephone line, and the transmitter 4 and receiver 5 connected in a bridge maintained normally open by contacts of the switch-hook 6. At the central office the limbs of the line terminate in the spring contacts of the cut-off relay 7 and are normally connected thereby, one with ground and the other through the coil of the line relay 8 with battery. The line relay 8 controls the line signal 9 in the usual way. The tip and sleeve contacts

10 and 11 of the jacks are adapted to be connected with the limbs of the telephone line when the cut-off relay 7 is actuated, at which time the line relay will be disconnected from the telephone line.

The cord circuit shown in connection with my invention is of the well known four relay type and has the tip and sleeve answering supervisory relays 15 and 16 connected respectively between the tip and sleeve strands of the cord circuit and the ground and live poles of the main battery A. These relays control the circuit of the supervisory signal 17. The calling end of the cord circuit likewise has the tip and sleeve supervisory relays 18 and 19 similarly connected, respectively between the tip and sleeve strands and the ground and live pole of the battery A. These relays control the circuit of the supervisory signal 20. Relay 19 also controls the normally open contacts 21 and 28 which maintain a normal separation between the calling end of the tip strand of the cord circuit and the coil of relay 18. The contact 21 is normally connected with contact 22 which normally connects the tip of the calling plug with the contact 23 of the operator's listening key 24. The contact 23 is adapted when the listening key is actuated to connect with contact 25 which in turn connects with earth through the impedance coil 26. This contact also connects with one terminal of the condenser 27, the other terminal of the condenser being connected through the tertiary of the operator's induction coil with the live pole of battery A. The main springs of the operator's listening key 24 are adapted when actuated to connect with the operator's receiver circuit and place the receiver in a bridge between the talking strands of the cord circuit. The operator's ringing key 30 has the tip and sleeve springs 31 and 32 adapted when actuated to connect with generator and battery to place ringing current upon the tip and sleeve contacts 33 and 34 of the calling plug.

The trunk circuit connecting the two exchanges is of the character known as a two-way trunk, that is, it is adapted to be used either in completing a call from a subscriber of the main exchange to a subscriber of the

branch exchange, or from a subscriber of the branch exchange to a subscriber of the main exchange. The main exchange end of this trunk circuit is equipped with answering and multiple jacks appearing before the various operators in the same manner as the individual line jacks of the exchange. The sleeve contact 36 is also connected with one terminal of condenser 38, the other terminal of the condenser being connected through the impedance coil 39 with the live pole of battery A and also with the normally disconnected inside contact 40 of cut-off relay 37. The tip contacts 42 of the jacks are connected with the normally open inside contact 43 of the cut-off relay 37. The tip spring 44 of cut-off relay 37 is normally connected through contact 45 and the coil of line relay 46 with ground. The sleeve spring 47 of cut-off relay 37 is normally connected through contact 48 with the live pole of battery A. The line relay 46 controls normally open contacts 50 and 51 in the circuit of the line lamp 52.

The tip and sleeve contacts 44 and 47 of cut-off relay 37 connect respectively with the trunk line conductors 54 and 55, these conductors being connected with the tip and sleeve strands 56 and 57 of the connecting circuit at the branch exchange. The condenser 58 and drop 59 are connected in a bridge between the trunk line conductors at the branch exchange. The end of the connecting circuit at the branch exchange which connects with the trunk line is provided with the key 82 which is adapted when actuated to place the impedance coil 83 in a bridge between the line conductors. The tip talking strand of the connecting circuit has its continuity interrupted by condenser 84 around which is bridged the coil of the supervisory relay 85. The sleeve conductor 57 has the non-inductive resistance 60 serially included therein to prevent short circuiting the battery B as the calling plug is being inserted into the line jack. The relay 85 has the normally closed contacts 62 and 63, contact 62 being connected through the supervisory signal 64 with the live pole of battery B, and the contact 63 being connected through conductor 65 with the sleeve contact 66 of the calling plug. Relay 85 also has the normally closed contacts 67 and 68, the contact 67 being connected with the sleeve talking strand 57 and the contact 68 being connected with the live pole of battery B. The tip and sleeve talking strands 56 and 57 terminate in the tip and ring contacts 70 and 71 of the calling plug, these strands including normally closed series contacts of the operator's ringing key 72. The operator's listening key 73 is adapted to connect the operator's receiver in a bridge between the talking strands of this connecting circuit.

The subscriber's station 1' of the branch exchange is equipped with apparatus similar to that of subscriber's station 1, the corresponding apparatus being designated by like figures having the suffix "'". The jack for this line is, however, of the three-conductor cut-off type and has the sleeve contact 75 permanently connected with ground, and the tip and ring contacts 76 and 77 normally connected through the inside contacts 78 and 79 respectively with ground and, through the coil of line relay 80, with the live pole of battery. The line relay 80 controls the line lamp 81 in the usual way.

The operation of the system will first be described as it occurs when the call originates with a subscriber of the main exchange. In that case subscriber No. 1 removes his receiver 5 from the switch-hook 6 and completes a path from battery through the coil of the line relay 8, the normal contacts of the cut-off relay 7 and the telephone line to ground through the other normal contacts of the cut-off relay 7. The actuation of the line relay 8 displays the line lamp 9 and the operator inserts her answering plug in the jack designated by the display of that lamp. This completes the circuit of the cut-off relay and effaces the line lamp and also completes the circuits of supervisory relays 15 and 16 and leaves the signal 17 in its normal condition, its circuit being closed at contacts of relay 16 and again opened at contacts of relay 15. The operator now throws her listening key 24 and inquires the desired number, and finding it to be the private branch exchange touches the tip of her calling plug to the sleeve or test contact of a multiple jack connecting with one of the trunk lines extending to the desired exchange. If the trunk line is busy the sleeve contact of the jack 36 will be in connection with the sleeve contact of some other cord circuit and will therefore be at a potential higher than ground. Current will therefore flow from the sleeve of the jack through the tip contact 33, through normally closed contacts 21 and 22 of supervisory relay 19, the now closed contacts 23 and 25 of the listening key 24 and the impedance coil 26 to ground. Current in this path will cause a slight discharge of the condenser 27 which will in turn cause a disturbance in the operator's receiver circuit and will indicate to the operator that the trunk is busy. A private branch exchange is usually provided with several trunk lines and the operator then proceeds to test the lines one at a time until she finds one that is idle.

When an idle trunk is found the operator inserts the plug into the jack and thereby completes a circuit from the live pole of battery A through the coil of supervisory relay 19, over the sleeve strand of the cord circuit, the sleeve contacts 34 and 36 of the

plug and jack and through the coil of cut-off relay 37 to ground. No direct current can flow through the condenser 38, the character of a condenser being such as to pass alternating currents but to completely obstruct the flow of direct currents. The current in the path described actuates relays 37 and 19. The actuation of relay 37 moves the springs 44 and 47 from their normal condition into connection with the contacts 43 and 40, and the actuation of relay 19 closes the circuit of the supervisory signal 20, displaying that signal. The operator now throws her ringing key 30 which connects the ringing generator with the tip strand of the trunk circuit. Current therefore flows from the generator through the spring 31 of the ringing key, contacts 33 and 42 of the plug and jack, contacts 43 and 44 of cut-off relay 37, line conductor 54, condenser 58, drop 59, line conductor 55, contacts 47 and 40 of cut-off relay 37, condenser 38, sleeve contacts 36 and 34 of the jack and plug and the spring 32 of the ringing key back to the live pole of battery A. The ringing current in this path actuates the drop signal at the private branch exchange and indicates to the operator that a connection is desired. The operator now throws her key 82 which completes a circuit of high impedance between the limbs 54 and 55 of the trunk circuit. Current therefore flows from the live pole of battery A, through the impedance coil 39, contacts 40 and 47 of the cut-off relay 37, line conductor 55, the sleeve contacts of the key 82, impedance coil 83, the tip contacts of key 82, line conductor 54, contacts 44 and 43 of the cut-off relay 37, tip contacts 42 and 33 of the jack and plug, the now closed contacts 21 and 22 of supervisory relay 19, and the coil of supervisory relay 18 to ground. The current in this path actuates the supervisory relay 18 and effaces the supervisory signal 20 indicating to the operator at the main exchange that the operator at the private branch exchange has answered the call. The operator at the private branch exchange now throws her listening key 73 and obtains the name or number of the private branch subscriber desired. She then inserts her calling plug into the jack and throws her ringing key 72. The insertion of the plug into the jack spreads the tip and ring contacts 76 and 77 and disconnects them from contacts 78 and 79. The ringing key 72 is now thrown completing a circuit which sounds the annunciator at the desired subscriber's station. Upon the insertion of the plug current flows from the live pole of battery B through the signal 64, contacts 62 and 63 of relay 85, conductor 65 and the sleeve contacts 66 and 75 of the plug and jack to ground, thereby displaying the supervisory signal 64. When the called subscriber answers his call cur-

rent flows over the path before described to the talking strand 57 of the connecting circuit and thence through resistance 60, ring contacts 71 and 77 of the plug and jack, the subscriber's line, tip contacts 76 and 70 of the jack and plug and the coil of relay 85 back to the ground pole of battery at the main exchange over the path formerly described. This actuates relay 85 and opens its contacts 62 and 63 to indicate to the branch operator that the desired subscriber has answered his call. The actuation of relay 85 also opens its contacts 67 and 68 and disconnects the battery B from the sleeve strand of the talking circuit. The operator now releases her key 82 so that all of the current which flows through the supervisory relay 18 at the main exchange also flows through the branch subscriber's station 1'. When the subscriber at this station terminates his conversation and hangs up his receiver he severs the circuit both through the relay 85 at the branch exchange and the relay 18 at the main exchange, allowing these relays to fall back to again complete the circuits of supervisory signals 64 and 20, indicating to each of the operators that the conversation has been terminated.

When the call arises at the branch exchange subscriber's station the operation is substantially the same. The operator seeing the line lamp 81 displayed inserts her plug into the jack and throws her listening key to obtain the desired number. If then, as is often the case, the operator proceeds herself to obtain the number for the branch exchange subscriber, she next throws her key 82 which completes a circuit from the live pole of battery A through contacts 48 and 47 of cut-off relay 37, line conductor 55, impedance coil 83, line conductor 54, contacts 44 and 45 of cut-off relay 37 and the coil of line relay 46 to ground. The current in this path actuates the line relay 46 and closes its contacts 50 and 51 in the circuit of the line lamp 52. Upon observing the display of this lamp the operator at the main exchange inserts her answering plug into the answering jack and completes the connection in the same manner as before described.

It will be noted that whenever the trunk circuit is not in use the auxiliary battery B located at the branch exchange is connected through contacts 68 and 67 of relay 85, conductors 57 and 55 and the normally closed contacts 47 and 48 of cut-off relay 37 with the live pole of battery A. This maintains the battery at the branch exchange charged to a potential substantially equal with that of the main exchange battery and, owing to the fact that there are usually several trunk lines leading to the private branch exchange, the storage batteries at that exchange may be of very low amperage.

While I have shown and described my invention with respect to certain details, it will be understood that I do not wish to be unduly limited thereto, many modifications being possible without departing from the spirit or scope of my invention.

I claim:

1. In a telephone trunking system, the combination with main and branch exchanges, of a battery at each exchange, a trunk line adapted to complete conversational connections between the exchanges, said batteries being each connected with said trunk line only whenever the trunk line is not in use for conversation, whereby the battery at the branch exchange will be maintained charged by current from the battery at the main exchange, substantially as described.

2. In a telephone trunking system, the combination with main and branch exchanges, of a trunk circuit adapted to connect the main and branch exchanges for conversation, a source of current at the main exchange normally connected with a limb of said trunk line, and a battery at the branch exchange normally connected with said limb of the trunk line whereby the battery will be maintained charged by current from the source at the main exchange, said batteries being connected for charging only when said trunk is not connected for a conversational circuit, substantially as described.

3. In a telephone trunking system, the combination with main and branch exchanges, of a trunk line connecting the exchanges for conversational purposes, a source of current at the main exchange having a pole connected to a limb of said trunk line whenever the trunk is not in use for conversational purposes, and a battery at the branch exchange having its like pole connected with said limb of the trunk line only whenever the trunk is not in use for conversational purposes, substantially as described.

4. In a telephone trunking system, the combination with a branch exchange and a main exchange, of a trunk line extending from the branch exchange to the main exchange, a source of current at the main exchange, a line relay normally connected between one limb of said trunk line and a pole of said source, the other limb of the trunk line being connected with the other pole of said source, a cut-off relay at the main exchange adapted to disconnect the limbs of the trunk line from their normal connections with said source, a two-conductor jack at the main exchange, the coil of said cut-off relay being connected with one of the contacts of said jack, said contact forming a portion of the talking circuit, a cord circuit to connect with said jack to

furnish current for the operation of said cut-off relay, and means to prevent direct current in the trunk line from passing through the coil of said cut-off relay, substantially as described.

5. In a telephone trunking system, the combination with a main exchange, of a branch exchange, a source of current at the main exchange, and a source of current at the branch exchange, a trunk line extending between the exchanges and terminating at the main exchange in the contacts of a jack, a cut-off relay connected between a talking conductor of said trunk line and the common pole of each of said sources, and means permitting the actuation of said cut-off relay from the source at the main exchange but preventing the actuation of said relay by current from the source at the branch exchange, substantially as described.

6. In a telephone trunking system, the combination with main and branch exchanges, of separate sources of current at each exchange, a trunk line extending between the exchanges to connect the same for talking purposes, a relay having one terminal of its coil connected with a common pole of said sources, and the other terminal of its coil connected with a limb of said trunk line, means to actuate said relay from the source at the main exchange, the two sources being normally connected with the same limb of the trunk line, and means to prevent the actuation of said relay by current from the source at the branch exchange, substantially as described.

7. In a telephone trunking system, the combination with main and branch exchanges, of a trunk line extending between the exchanges and terminating at the main exchange in a two-contact jack, a source of current at each exchange normally connected together over the trunk line, a cut-off relay bridged from one limb of the trunk to ground at the main exchange and a condenser in the trunk line to prevent current from the source at the branch exchange from locking the cut-off relay, substantially as described.

8. In a telephone trunking system, the combination with main and branch exchanges, of a source of current at each exchange, a trunk line extending in two limbs between the exchanges and normally connecting the like poles of said sources together, and means effective upon connection made with said trunk line to automatically efface said connection.

9. In a telephone trunking system, the combination with main and branch exchanges, of a source of current at each exchange, a trunk line extending between the exchanges, means normally connecting the like poles of said sources with said trunk line for charging purposes, and means ef-

fective upon connection made with said trunk line to automatically efface said connection.

10. In a telephone exchange system, the combination with a main exchange, and a branch exchange, of a trunk line for establishing conversational connections between subscribers in the said exchanges, a source of current at one exchange, a battery at the other exchange, a circuit including a limb of the trunk circuit for connecting the said source of current and said battery, whereby

the battery will be maintained charged, and means for effacing the said charging circuit when the trunk is connected for a conversational circuit, substantially as described. 15

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

CHARLES A. SIMPSON.

Witnesses:

CLIFFORD C. BRADBURY,
MARJORIE E. GRIER.

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