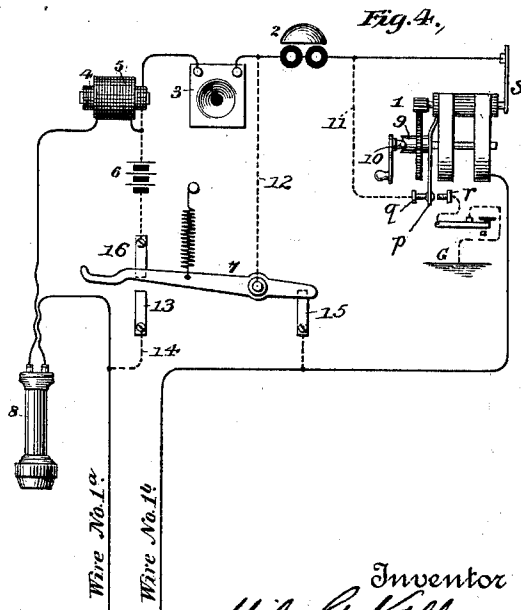
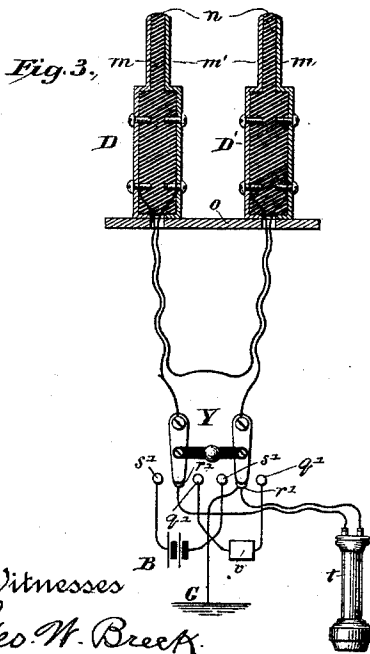
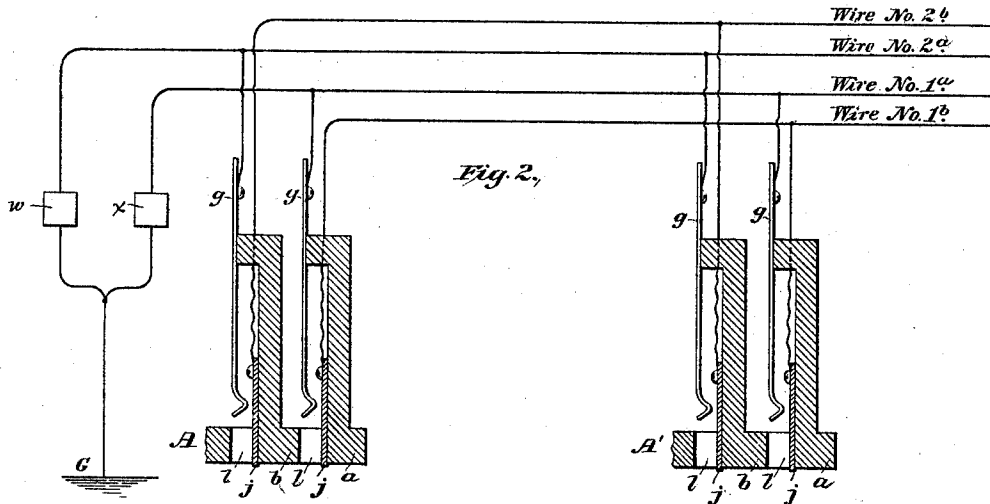
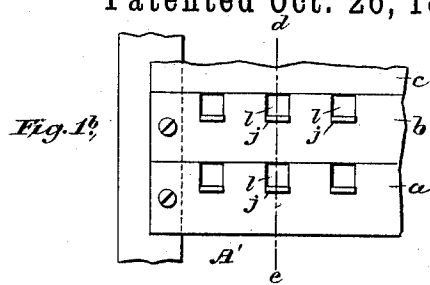
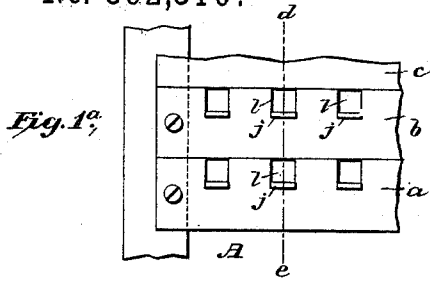


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,310.

Patented Oct. 26, 1897.



Witnesses
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UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF SAME PLACE.

MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,310, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,012. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, Illinois, temporarily residing at Stuttgart, in the Empire of Germany, have invented certain new and useful Improvements in Multiple Switchboards for Telephone-Exchanges, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a telephone-exchange system in which the subscribers' lines are metallic-circuit lines, connected to multiple switchboards; and it consists in a system of testing at any board to determine whether any line is in use. I place as many switchboards in the central office as are found necessary or desirable in order to properly answer the calls and connect and disconnect the subscribers' lines. On each board I place for each line a spring-jack or other switch having two contact-pieces which are insulated from each other except by the circuit connections. Said switches are each adapted to receive a loop-switch plug, and when a plug is inserted to connect the two contact-pieces of the plug with the two contact-pieces of the switch, respectively, one of the contact-pieces of each switch should be so placed that a test-plug or similar device may be readily applied to it or so connected to a test-bolt that it can be readily connected with it. At each subscriber's station is a battery, which for purposes of testing should be so placed and connected that it sends a current to line when the subscriber's telephone is in position for use and should be so switched that it sends no current to line when the telephone is in its position where it is not in use—that is, on the switch. This battery may be the same as that which is used with the telephone-transmitter.

Figures 1^a and 1^b of the drawings are front views of sections of two multiple switchboards to which the same lines are connected. Fig. 2 is a diagram of the boards and their circuits and connections, illustrating my invention. Fig. 3 shows an operator's cord system adapted to be used with the switchboards. Fig. 4 is a diagram of the subscriber's-station apparatus, illustrating my invention.

In the drawings like parts and apparatus are indicated by the same letters of reference.

In Fig. 2, A is a sectional view of the switchboard shown in Fig. 1^a, and A' is a sectional view of the switchboard shown in Fig. 1^b, each as indicated by the line *d e*.

a b represent rubber strips, of the shape substantially as shown, on which the metal parts of the switches are mounted. These strips may be of a length to receive any convenient number of switch parts.

ll are square holes through the fronts of and at the edges of the strips adapted to receive and guide the switch-plugs. The contact-springs *g g* are mounted to the rear of and are parallel to the holes *ll*, to which they belong, as shown. *jj* are contact-pieces of the switches so placed as to make the switch connections hereinafter described and also to be readily connected with a test-plug for purposes of testing. The switch-plugs are substantially as shown in Fig. 3. The several parts are so made, shaped, and adjusted that when a switch-plug is inserted into a switch the two contact-pieces of the plug form connection, respectively, with the two contact-pieces of the switch.

w and *x* in Fig. 2 are two line-annunciators in the central office for receiving signals from the subscribers' stations.

In the operator's cord system shown in Fig. 3 only one pair of cords, with its plugs, switch, clearing-out annunciator, telephone, and calling generator or battery, is shown. Other pairs with their parts could be added and connected in a manner which will be apparent to those skilled in the art. One system of pairs of cords is placed at each board for an operator, and the parts are so mounted that the operator can conveniently operate the board.

The two plugs D and D' are composed of insulating material *n*, upon which are mounted two plug-contacts *m* and *m'*, normally or when the plugs are at rest, cross-connected by the conducting base-plate *o*. The two contacts *m'* are connected together by a flexible conductor *d'*. The two plug-contacts *m* are connected together by a flexible conductor *d*, in the circuit of which is a looping-in switch Y, adapted to be placed upon pairs of contact-bolts *q' q'*, *r' r'*, or *s' s'* and thereby loop into the circuit the clearing-out annunciator *v*, the operator's telephone set *t*, or the alternating call-generator B. When one plug is

inserted into a switch of a line, the circuit of this apparatus is completed through the cross-connected contacts of the other plug. This cross connection is assisted by the weight which is usually used with a flexible cord conductor. One of the contact-bolts r' is grounded, as shown, so that the plug connected to the other bolt r' may be used for testing whenever the looping-in switch Y rests upon these bolts. In this way an operator's test outfit is provided, and in Fig. 3 this test outfit may be traced from the contact m of the plug D, flexible conductor d , one lever of the looping-in switch Y, contact-bolt r' , telephone set t , to the other contact-bolt r' , which is grounded at G.

Each operator needs only one calling-generator and one telephone for her cord system. She should have as many looping-in switches and clearing-out annunciators as she has pairs of cords.

In the subscriber's - station apparatus shown in Fig. 4 1 is the calling-generator, 2 is the signal-bell, 3 is the transmitter, 4 is the primary of the induction-coil, 5 is the secondary of the induction-coil, 6 is the transmitter-battery, 7 is the telephone-switch, and 8 is the hand-telephone. These parts may be of the usual forms and are connected as shown or in other ways to produce the required results.

In the drawings one side or branch of the line—say wire No. 1^b —is connected to the metal frame of the generator. The other side or branch of the line is connected to the insulated spring s , which bears on an insulated piece on the armature-shaft, to which one end of the armature-coil is connected. The other end of the armature-coil and the commutator-spring p are in connection with the metal frame of the generator. Contact-point r is connected with the ground through a normally-closed key, and point q is connected to the wire which leads to spring s .

The calling-generator is constructed as follows: It has an automatic device (shown in the drawings) by which when the crank is not in motion the wire of the armature is shunted and the line is disconnected from the ground at the subscriber's station, and when it is turned or operated the shunt is automatically removed from the armature and the line is temporarily connected to the ground. The reason for this will hereinafter be apparent.

The automatic device shown in Fig. 4 comprises the usual V-shaped attachment 9, loosely mounted on the arbor of the driving-wheel and rigidly connected to the driving-wheel. The pin 10 on this arbor normally engages the V-shaped attachment in such a way that when operated it causes the wheel to move longitudinally on the arbor, causing the contact-spring p to rest upon the back contact r , thus connecting the frame of the generator to ground. While the generator is at rest the spring p presses the driving-wheel outward and makes connection with the short-

circuiting contact q . When the wheel is pressed outward, the pin 10 slides into the middle of the V-shaped attachment.

The contact-points and the circuits are substantially as shown and such as will produce the results which I have described above.

The generator should be connected into the line-circuit, so that the temporary ground is made between the normally open end of the subscriber's line and the armature-coil.

In Fig. 4 I have represented the gravity-switch 7 ordinarily used with the hand-telephone 8. It is of course obvious that any other kind of switch may be used as long as substantially the same functions are accomplished.

The connection of a subscriber's line may be traced from test-contacts j in each of the line-jacks, line conductor No. 1^b , to the subscriber's station, the generator 1 normally short-circuited by the conductor 11, bells 2, short circuit 12, switch-lever 7, contact 13, normally connected thereto, short circuit 14, line-wire No. 1^a , to central, annunciator x to ground at G. When the telephone is removed from the hook, the subscriber's circuit is transferred as follows: line conductor No. 1^b , contact 15, switch-lever 7, connected thereto while the telephone is switched for use, contact 16, transmitter and test-battery 6, secondary coil 5 of the induction-coil, hand-telephone 8, and line conductor No. 1^a . At the same time the following local circuit is established: switch-lever 7, conductor 12, transmitter 3, primary coil 4, battery 6, and contact 16, connected to the switch-lever under the conditions described. Battery 6 is thus connected in derivation with the local transmitter-circuit and the line-circuit. The amount of current circulating in these two circuits depends upon their comparative resistances. The current circulating in the line-circuit is utilized for the purpose of testing. Whenever the two conductors of the line-circuit are cross-connected through a test receiving instrument, the test receiving instrument will sound or give a click in response to this current. This click only occurs when the telephone is switched for use and is prevented when the telephone is restored to the switch and the subscriber's test-battery is left on open circuit.

G in each case in the drawings represents a ground connection.

The operation of the system is as follows: When a subscriber desires to call, he turns the crank of his generator and thereby temporarily connects his line with the ground, and, sending a calling-current over it, operates his line-annunciator at the central office. He then removes his telephone from its switch and the operator at the central office places D' (one of the plugs of a pair of plugs) in the switch of the line where the call is indicated, and, placing the lever of the switch Y, corresponding with the pair of plugs used, on the contact-bolts connected with her tele-

phone-loops finds out what line is wanted. She then places the contact-piece *m* of the other plug D of the pair on the contact-piece *j* of the switch of the line wanted as a test. A complete circuit is thereby established as follows: from the ground, through the operator's telephone, to contact-piece *m* of the plug D, thence to the line through the contact-piece *j* of the line-switch and over the line through telephone and battery 6 if the telephone is off of its switch and back to the office ground through the other branch of the line. If when the test is thus made the subscriber's telephone of the line tested is on its switch, there will be no current on the test-circuit thereby established and the test receiving instrument will not respond. If, however, the subscriber's telephone is off from its switch, (for use,) there will be a current over the test-circuit established and the instrument will respond. The operator can therefore determine on testing whether or not any line is in use. If the test indicates that the line is not in use, the operator will place the plug D in the switch of the line. The two lines are thereby connected together in metallic circuit. By moving the levers of the looping-in switch belonging to the pair of cords used the operator may loop her calling-generator into the circuit of the two lines and send a signaling-current over the circuit from her calling-generator. Again, by moving the levers of the switch she may switch a clearing-out annunciator into the circuit and so leave it while the wires are connected for conversation, and, again, by moving them she may switch her telephone into the circuit to determine by listening whether the subscribers are through conversation. It will be observed that in this system of switching and testing the office ground of a line is not removed when a line is switched with another line. This does not interfere with the working of the telephone system, as it is well known that one ground on a metallic telephone-circuit does not interfere with its operation, nor will the ground connection of the loop interfere with conversation when the operator's telephone is looped into the circuit of the two subscribers.

The batteries of the different lines should be connected in their circuits in the same direction—that is, so that each has the same pole toward the permanently-grounded end of its line. Two lines when connected together in metallic circuit will then have their batteries in opposition to each other in the metallic circuit; but when a test is made of either of two connected lines the two batteries at the subscribers' stations will be in parallel circuit with each other with reference to the test receiving instrument and will act together and not in opposition in the test receiving instrument.

If the switch-plug D is used for testing, as described, the ground connection of the pair of cords should be placed between the oper-

ator's telephone and the contact-piece *m* of the other plug. The other plug could be used by reversing the position of the ground connection to the other side of the telephone.

The call-annunciators and the clearing-out annunciators should be so related to the test-battery as not to be operated thereby. The usual annunciator and the usual subscriber's battery answer these conditions.

The plugs D and D' should be so inserted in the jacks that the contacts *m'* of the plugs make connections with the contacts *j* of the jacks. This is not necessary, for it is obvious that the plugs may be reversed. This insertion is preferable, however, because a subscriber may then operate his calling-annunciator while connected with another subscriber for conversation by omitting to open the key-contacts 17 in the ground connection of his outfit, so that when a subscriber operates his calling-generator not only does a circuit exist over the metallic line conductor, but a grounded circuit exists through his calling-annunciator, shunting the metallic circuit in such a way that the clearing-out annunciator is not operated. Thus a subscriber controls both the clearing-out annunciator and his call-annunciator, and if an operator has connected him to a subscriber who does not respond to his call he may again secure the attention of the operator.

To prevent the operation of the subscriber's call-annunciator while clearing out, the subscriber opens the contact 17.

When two lines are connected together and both subscribers hang up their telephones and carelessly omit to send in any clearing-out signal, the lines are said to be "tied up." If now an operator at any other board tests either of the connected lines, his test receiving instrument will remain silent, because the subscribers' test-batteries will be on open circuit and the line tested will indicate "free." The testing operator then connects the tested line with the calling-line with the result that the calling-line forms a bridge across the tied-up circuit, and when the operator loops her call-generator into this bridge for calling not only do the subscribers' bells ring, but the clearing-out annunciator is operated at the board where the two lines are tied up, and the operator thereat seeing the disconnection-signal disconnects the tied-up lines. Thus when lines are left in this condition the condition is dissolved when either line is wanted. Both connected lines would test free and be connected to and their tied-up connection would be dissolved if they were both wanted at the same time. It will also be observed that although the line-annunciators are not cut off from their lines when the lines are switched for conversation they are actually switched from the metallic circuit by the conductor *d*, containing the clearing-out annunciator, which acts as a shunt around the two annunciators, so that enough of the clearing-out current is shunted from the line-

annunciators to prevent their operation. The circuit of a clearing-out current may be traced from one pole *s* of the subscriber's generator, line conductor No. 1^a, to central, to contact *g* of the switch, where the line is connected through the annunciator to the common ground connection, thence through the annunciator of the other connected line to the contact *g* of the jack, where the other line is connected, these annunciators being short-circuited by the conductor *d*, containing the clearing-out annunciator, connected to the two contact-springs *g g* of the two lines, thence over the line conductors Nos. 2^a and 2^b to contacts *j* of the latter line, conductor *d'*, contact *j* of the former line, line conductor No. 1^b, back to the other pole of the subscriber's generator.

Although the ground has been shown as forming part of the call and test circuits, it is obvious that a metallic conductor might be substituted therefor. To effect this, a connection to a common wire would be substituted for each ground connection. By this system of testing and switching only two contact-pieces are required for each switch and only two leading-in wires, as in other metallic-circuit multiple-switchboard systems.

In sending clearing-out signals the subscriber manipulates the normally-closed key in the ground connection of his generator to open the circuit and then operates the generator. There is then no circuit through the line-annunciators and they will not be operated, but the clearing-out annunciator in the circuit of the lines will be operated.

I do not herein claim the switching system herein described irrespective of the test-battery and apparatus herein claimed, as such switching system forms the subject of claims in another of my pending applications.

I claim as my invention and desire to secure by Letters Patent—

1. In a telephone-exchange system, a metallic-circuit line normally open at one end at the central office and permanently grounded at its other end at the central office and normally grounded there only, in combination with the transmitter-battery in the circuit of the line at the subscriber's station when his telephone is switched for use and then only, and a test receiving instrument at the central office grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with the normally open end of the line, substantially as set forth.

2. In a telephone-exchange system, two or more multiple switchboards at the central office, and metallic-circuit lines, each line being normally open at one end and connected to the boards and at its other end permanently grounded at the central office and connected to the boards, and normally grounded there only, in combination with the transmitter-battery in the circuit of the line at the subscriber's station while his telephone is switched for use and then only, and test re-

ceiving instruments, one at each board, each instrument grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with the normally open end of any line, substantially as set forth.

3. In a telephone-exchange system, multiple switchboards, a metallic-circuit line and switches for the line, one switch on each of the boards, each switch having a contact-point connected to the line and permanently connected to the ground and a second contact-point connected to the line on its other side in combination with the transmitter-battery in the circuit of the line while the subscriber's telephone is switched for use but not otherwise and test receiving instruments, one at each board, each instrument grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with said second contact-piece at its board, substantially as set forth.

4. In a telephone-exchange system, multiple switchboards, metallic-circuit lines, and switches, one switch on each board for each line, each switch having two contact-points one connected to one side of the line and permanently connected to the ground, and the second contact-point connected to the other side of the line, in combination with the transmitter-battery in the circuit of each line while its subscriber's telephone is switched for use but not otherwise, and test receiving instruments, one at each board, each grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with any of said second contact-pieces at its board, substantially as set forth.

5. In a telephone-exchange system, two metallic-circuit lines switched together in multiple circuit for conversation and grounded at the central office and there only, in combination with transmitter-batteries, one at each of the subscribers' stations and each in the circuit of its line while its subscriber's telephone is switched for use but not otherwise said batteries being connected in said metallic circuit in opposition to each other, that is, with their like poles connected together, and a test receiving instrument grounded at one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with either metallic-circuit line with the line-battery between said test connection and said ground connection, substantially as set forth.

6. In a telephone-exchange system, multiple switchboards, two metallic-circuit lines connected to said boards and temporarily connected into a metallic circuit at one board for conversation and said circuit being grounded at the central office but not elsewhere, in combination with transmitter-batteries, one at each of the subscribers' stations and each in the circuit while its subscriber's telephone is

switched for use but not otherwise, said batteries being connected in said metallic circuit in opposition to each other, that is, with their like poles connected together, and test receiving instruments, one at each of the other boards, each instrument grounded on one side and connected on its other side to a test plug or device adapted for testing to be brought into connection with either line with the line-battery between said test connection and said ground connection, substantially as set forth.

7. In a telephone-exchange system, a test receiving instrument at one board, and two metallic-circuit lines temporarily connected at another board into a metallic circuit for conversation and said circuit being connected to one side of said test receiving instrument, in combination with transmitter-batteries, one at each of the subscribers' stations and each in the circuit of its line while its subscriber's telephone is switched for use but not otherwise, said batteries being connected into said metallic circuit in opposition to each other, that is, with their like poles connected together, and a test plug or device at said first-named board adapted to be brought for testing into connection with either line with the battery between said test connection and said connection with the test receiving instrument and said instrument being connected on its other side to said test-plug, substantially as set forth.

8. In a telephone-exchange system, multiple switchboards, test receiving instruments, one at each board and two metallic-circuit lines temporarily connected together for conversation and their circuit connected to one side of each of said test receiving instruments, in combination with transmitter-batteries, one at each of the subscribers' stations, each in the circuit of its line while its subscriber's telephone is switched for use but not otherwise and connected into said metallic circuit in opposition to each other, that is, with their like poles connected together, and test-plugs, one for each test receiving instrument and connected to it on the other side, the test-plug at any board where the lines are not switched being adapted to be brought into connection with either line with the line-battery between said test connection and said connection of the circuit with the test receiving instruments, substantially as set forth.

9. In a telephone-exchange system, multiple switchboards, metallic-circuit lines connected to the same, switches on the several boards to connect any two of said lines together in metallic circuit for conversation, said lines when thus connected being grounded at the central office but not elsewhere, in combination with transmitter-batteries, one at each subscriber's station, each in the circuit of its line while its subscriber's telephone is switched for use but not otherwise, and said batteries being then connected in the same direction with reference to said office ground

connection, that is, with their like poles connected together, and test receiving instruments, one at each board, each grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with any line with the battery (when in the circuit) between said test connection and said ground connection, substantially as set forth.

10. In a telephone-exchange system, multiple switchboards, test receiving instruments, one at each board, metallic-circuit lines, switches on the several boards to connect any two of said lines together in metallic circuit for conversation, said lines when thus connected being connected to one side of each of said instruments, in combination with transmitter-batteries, one at each subscriber's station, each in the circuit of its line while its subscriber's telephone is switched for use but not otherwise, said batteries when thus connected being in their circuits in the same direction with reference to said connection with the test receiving instruments, that is, with their like poles connected together, and test plugs or devices, one for each instrument and connected to it on the other side, each plug being adapted to be brought for testing into connection with any of said lines with the line-battery (when in the circuit) between said test connection and said connection of the line with the test receiving instrument, substantially as set forth.

11. A test-circuit for a metallic-circuit line temporarily connected with another such line, from the ground through a test receiving instrument to a test-plug, thence to the line tested and through the circuit of the two lines in parallel circuit and transmitter-batteries, one at each subscriber's station, in the circuit when his telephone is switched for use but not otherwise, to the ground at the central office, said batteries being connected in the metallic circuit of said lines in opposition to each other, that is, with their like poles connected together, substantially as set forth.

12. A test-circuit for a metallic-circuit line temporarily connected with another such line, from one side of a test receiving instrument to a test plug or device at a board at which the line is not switched, thence to the line tested and through the circuit of the two lines tested in parallel circuit, thence to the other side of said test receiving instrument and transmitter-batteries, one at each subscriber's station, in the circuit when his telephone is switched for use but not otherwise, said batteries being connected in the metallic circuit of said lines in opposition to each other, that is, with their like poles connected together, substantially as set forth.

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