(No Model.) 3 Sheets—Sheet 1.

# M. G. KELLOGG.

## MULTIPLE SWITCH BOARD.

No. 386,886. Patented July 31, 1888.

Fig. 1a.

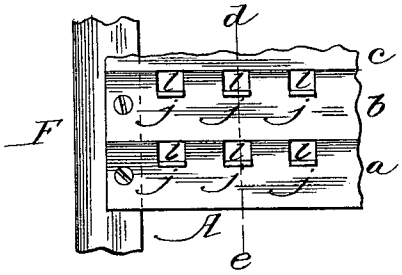



Fig. 1b.

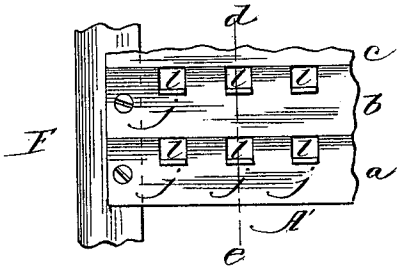
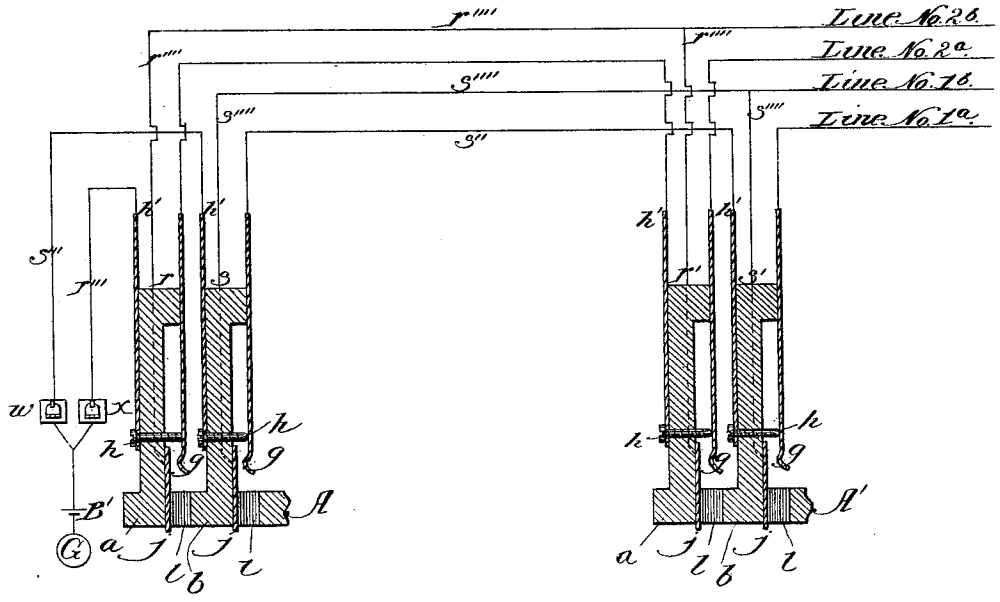



Fig. 2.




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# M. G. KELLOGG.

## MULTIPLE SWITCH BOARD.

No. 386,886. Patented July 31, 1888.

*Fig. 3.*

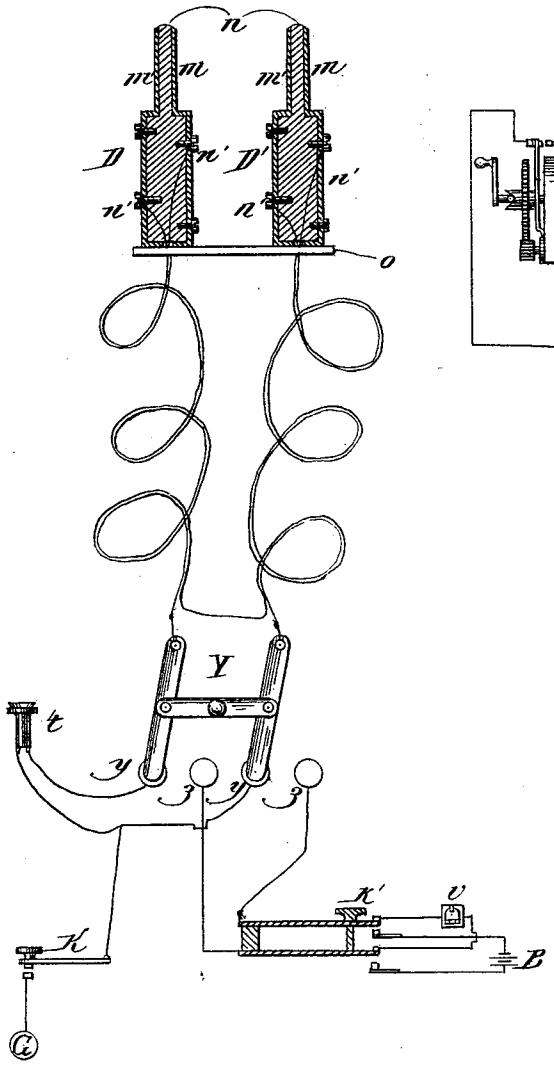
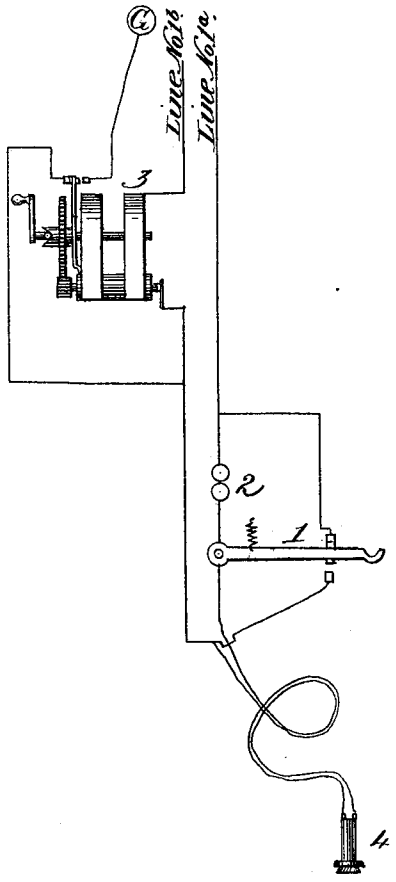



*Fig. 4.*




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(No Model.) 3 Sheets—Sheet 3.

# M. G. KELLOGG.

## MULTIPLE SWITCH BOARD.

No. 386,886. Patented July 31, 1888.

*Fig. 5.*

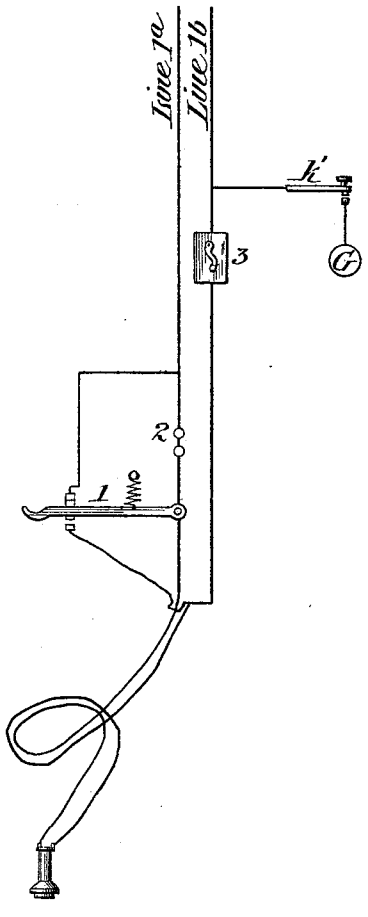
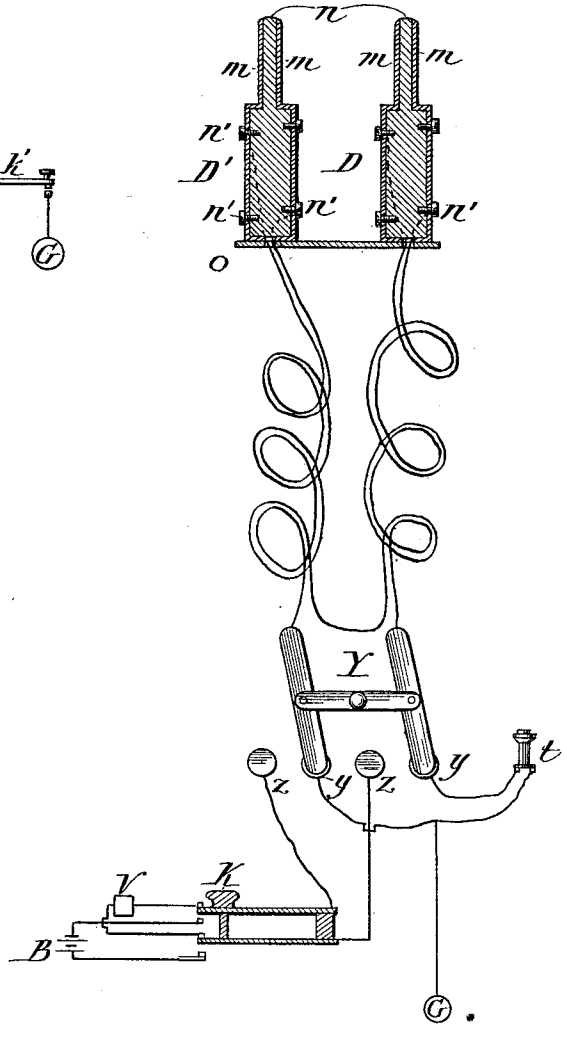



*Fig. 6.*




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N. PETERS, Photo-Lithographer, Washington, D. C.

# UNITED STATES PATENT OFFICE.

REISSUED

MILO G. KELLOGG, OF HYDE PARK, ILLINOIS.

## MULTIPLE SWITCH-BOARD.

SPECIFICATION forming part of Letters Patent No. 386,886, dated July 31, 1888.

Application filed July 30, 1887. Serial No 245,672. (No model.)

*To all whom it may concern:*

Be it known that I, MILO G. KELLOGG, of Hyde Park, Illinois, have invented certain new and useful Improvements in Multiple Switch-Boards 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 circuits, and in which one of the wires of a metallic circuit is normally grounded at the central office and the other wire is normally open at the central office.

It consists, first, of a multiple switch-board system of operating an exchange and testing at any board to determine whether any given line is in use, which system I shall hereinafter describe and claim in detail.

It consists, secondly, of an operator's central-office system of cords with plugs, switches, keys, telephone, battery or generator, clearing-out annunciators, and circuits for answering, calling, testing, switching, and clearing out subscribers' lines, which I shall hereinafter describe and claim in detail, said system being applicable to said multiple switch-board system mentioned above and to other systems of telephone-exchange switch-boards.

It consists, thirdly, of an arrangement of subscribers' station apparatus, which I shall hereinafter describe and claim in detail, said apparatus being applicable to said multiple switch-board system mentioned above and to other systems of telephone-exchange switch-boards.

In my system I use loop switch-plugs having two insulated metal pieces and two insulated flexible conductors attached to said pieces. I place as many switch-boards 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 telephone-line which centers at the office a spring-jack or similar switch having two insulated contact-points normally in contact and a third contact point or piece normally insulated from the others, except by the line-connections, said switch being adapted to receive a switch-plug, and when the plug is inserted to disconnect the switch-points which are normally in contact and connect one of them to one of the insulated metal pieces of the plug and at the same time connect the other metal piece of the plug to the third contact point or piece mentioned above.

The third contact point or piece of the switch above described is also placed and arranged so that the operator may, at will, apply a test-plug or other test device to it. A separate test bolt or piece might, however, be used for each line on each board, providing it was connected to the open end of its line.

The switches of a line on the different boards may be called "a series of switches," and the test-pieces of a line, or the contact-points when used as test-pieces, may be called "a series of test bolts or pieces."

Figures $1^a$ and $1^b$ of the drawings are front views of sections of two multiple switch-boards to which the same wires are connected. Fig. 2 shows a diagram of the boards and the circuits and connections necessary to operate them when used in connection with the operator's cord system and the subscriber's station apparatus hereinafter described. Fig. 3 is a diagram of the operator's cord system, and Fig. 4 is a diagram of the subscriber's station apparatus. Fig. 5 shows a modification of the subscriber's station apparatus, and Fig. 6 shows a modification of the operator's cord system.

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 switch-board shown in Fig. $1^a$, as indicated by line *d e*, and A′ is a sectional view of the switch-board shown in Fig. $1^a$, as indicated by line *d e*.

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

*l l*, &c., are square holes through the fronts and at the edges of the strips, adapted to receive the switch-plugs. The contact springs *g g*, &c., are mounted to the rear of and are parallel to the holes *l l*, &c., to which they belong, as shown. The contact-points *h h*, &c., corresponding to the contact-springs, pass through the rubber strips and have connecting-pieces *h′ h′*, &c., as shown.

*j j*, &c., are the contact-pieces of the switches, insulated from the rest of the parts, except by line-wires, each adapted to connect one side of its line to one of the contact-pieces of the plug when the plug is inserted into the switch, and also to be a test-bolt of its line at its board. The switch-plugs are substantially as shown in Fig. 3, and as will hereinafter be described.

The several parts mentioned above are so made, shaped, arranged, and adjusted that when a plug is inserted into any of the switch-holes it raises the spring in the rear of the hole from its contact-point, (on which it normally rests,) and the spring is connected to one of the contact-pieces of the plug, while the other contact-piece of the plug is connected to the contact-piece *j* of the switch which is being used.

Each section of a rubber strip, with its contact-spring, contact-point, contact-piece, and the hole, all arranged and operating as shown, may be considered as a spring-jack switch. The rubber strips are placed one above the other, as shown. The lower edge of one strip, therefore, provides the upper edges of the holes of the strip which is below it, as shown. It is not necessary that the switch-holes should be actually square, as their shape might be made to conform to the shapes and arrangement of the parts used.

The circuits and connections of a subscriber's metallic line to its series of switches are as follows and as shown: I have marked the ingoing and the outgoing wires of such a line as line No. $1^a$ and line No. $1^b$. *s* and *s'* are the switches for this line on the two boards. Line No. $1^a$, after entering the office, passes first to spring *g* of switch *s'*, and thence through contact-point *h* and connecting-piece *h'* of that switch and wire *s''* to spring *g* of switch *s*, and thence through contact-point *h* and connecting-piece *h'* of that switch and wire *s'''* to annunciator *w*, and thence to the common ground-wire and ground. Line No. $1^b$ is connected to the contact-pieces *j j* of the switches *s* and *s'* by wire *s''''* and its branches, (also marked *s''''*,) as shown. I have marked the two wires of another subscriber's metallic circuit-line as line No. $2^a$ and line No. $2^b$, and they are connected to their switches *r* and *r'*, as shown, and similar to the above. In like manner would the other lines of the exchange be connected to their switches.

Other boards might be added to the exchange, and the connections of the lines to their switches would be similar to the above and such as would be evident to those skilled in the art.

In the operator's system of cords shown in Fig. 3 only one pair of cords, with its plugs, switch, keys, clearing-out annunciator, telephone, and calling battery or generator, is shown. Other pairs, with their parts, could be added and connected in a manner which is 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.

D D' represent a pair of plugs in sectional view. *n* is the rubber insulation of the plug. *m* is one of its contact-pieces, and *m'* is the other contact-piece. The contact-pieces *m m'* extend to the bottom of the plug, as shown, and are adapted to rest normally (or when the plug is not in use for switching) on the metal piece *o*, which thereby connects them temporarily together.

Weights, as is usual, or similar devices, may be used to bring the plugs to the strip *o* and form a good connection.

T is a looping-in switch, having two pairs of contact-bolts, *y y* and *z z*, on which the operator may at will place the levers of the switch.

*v* is the clearing-out annunciator of the pair of cords.

*k'* is a looping-in key, constructed substantially in the manner as shown, whereby the operator may at will loop her calling-generator into the circuit of a pair of cords.

B is the operator's calling-generator. *t* is her telephone, and *k* is a test-key.

The cords have two insulated conductors, as shown, and should be long enough so that she may connect any plug with any switch at her board. Each operator needs but one calling-generator, one telephone, and one test-key for her system. She should have as many looping-in switches and as many looping-in keys as she has pairs of cords. The circuits are substantially as shown.

The testing-key may be dispensed with, and in that case the wire which is shown as branching off from one of the telephone-cords may connect directly to the ground. Fig. 6 shows such a modification of the apparatus.

In the subscriber's station apparatus shown in Fig. 4 1 is the telephone-switch, 2 is the signal-bell, 3 is the calling-generator, and 4 is the subscriber's telephone. These parts may be the usual forms of apparatus, and are connected as shown and in other known ways. The calling generator is, however, modified, as will hereinafter be described. Wire No. $1^a$ and wire No. $1^b$, (shown in this figure) are the two wires of a metallic circuit-line.

The generator 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 automatic device shown is a modification of a form very generally used, the modification being substantially in the arrangement of the contacts. It contains a V-shaped attachment to the hub of the driving-wheel, a pin in the shaft, which engages in the V-shaped arrangement, and a spring which presses against the wheel and brings the pin normally in the center of the V arrangement. The contact-points and circuits are substantially as

shown and as will produce the action described above. Other devices may be used, modified so as to produce this result. A common key or switch might be used and operated by the hand of the subscriber to ground the line when he is sending in a signal. The generator should be connected so that the temporary ground is made between the normally-open end of the subscriber's line and the armature-coil. This modification of the apparatus is shown in Fig. 5, in which *k'* is the key or switch referred to as operated by the hand of the subscriber.

I place a test-battery (marked B' in the drawings) in the common or ground wire of the lines at the central office. The operation of the system would be the same if this battery were placed in the wire which is used to connect the operator's telephone with the ground.

The operation of the system is as follows: When a subscriber desires to call, he turns the crank of his generator, and, thereby temporarily connecting his line with the ground and sending a calling-current over it, operates the line annunciator at the central office. The subscriber then removes his telephone from its hook or switch and the operator places D', one plug of a pair of plugs, in the switch of the line where a call is indicated, and, placing the levers of the switch Y corresponding to this pair of plugs on its bolts *y y*, the subscriber and the operator are connected together in metallic circuit for conversation. When the operator finds out what line is wanted, she places the piece *m'* of the other plug of the pair on the contact-piece *j* of the switch of the line wanted for a test, pressing, meanwhile, the key *k*. If the line tested is not in use, there will be a complete circuit from the ground at the central office through the operator's telephone, thence through the contact-piece *j* and the line, back to the central office and to ground, and the testing-battery will be in that circuit, and the operator, hearing a click in her telephone, will know that the line is not busy and will place the plug in the switch. She will then move the levers of the switch Y so that they rest on bolts *z z*, and, pressing on key *k'*, loop the calling-generator temporarily into the circuit. When she removes the pressure from key *k'*, the clearing-out annunciator will be in the circuit. Thus the subscribers are connected together in metallic circuit, are called, and are left for conversation with a clearing-out annunciator in their circuit. If, when the operator had made the test, as described above, the line tested had been switched at another board, it would have been disconnected from the ground and she would not have got the signal that it was not busy; she would not then have completed the connection. The operator can always, by moving the levers of the switch Y to *y y*, listen on her telephone to see whether the subscribers are through conversation. When they are through conversation, either one can turn the crank of his generator and send a clearing-out signal through their metallic circuit, which will operate the clearing-out annunciator left in the circuit. The automatic attachment of the generator will of course ground the circuit while he is sending the signal; but this will not prevent its operation.

When a pair of plugs are not in use, the levers of the switch Y corresponding to them should rest on *z z*.

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

1. In a telephone-exchange system, a metallic circuit subscriber's line normally disconnected from the ground at the subscriber's station, in combination with a calling-generator in the circuit of said line at the subscriber's station and a switch co-operating with the normally-open ground to close the same while the generator is being operated, substantially as set forth.

2. In a metallic circuit-exchange system, a subscriber's line normally disconnected from the ground at the subscriber's station and normally connected with a ground wire or connection at the central office, and a calling annunciator in said ground wire or connection, in combination with a calling-generator at the subscriber's station in the circuit of said line, a ground wire or connection at the subscriber's station normally open to the line, switching devices or means at the central office to temporarily disconnect said line from said ground wire or connection at the central office and connect it with another line for conversation, and switching devices or means at the subscriber's station to temporarily connect said line with said ground wire or connection at the subscriber's station while the generator is being operated, with the generator between the ground-connection and the calling-annunciator, substantially as and for the purpose set forth.

3. In a telephone-exchange system, a metallic circuit-line normally disconnected from the ground at the subscriber's station, one side or branch of which is normally connected to a ground wire or connection at the central office, the other side or branch of which is normally open at the central office, and a battery in said ground wire or connection, in combination with a switching device at the central office having a pair of contact-points to disconnect said line, at the will of the operator, from said ground wire or connection, a test-receiving instrument, and a switch-testing plug or device connected to one side of said test-receiving instrument, whereby the operator may at will connect said test-receiving instrument, grounded on one side, on its other side to said open end of said metallic circuit-line, substantially as set forth.

4. In a telephone-exchange system, a metallic circuit-line normally disconnected from the ground at the subscriber's station, a ground wire or connection at the central office, a bat-

tery in said ground wire or connection, and a switch at the central office having three contact-pieces, two of which are normally in contact with each other and are not in contact with the third piece, one of said pieces which are normally in contact being connected to said ground wire or connection with the battery between it and the ground, the other of said pieces being connected to one side or branch of said metallic circuit-line, and the other side or branch of said line being connected to said third contact-piece, in combination with a double switch-plug having two insulated contact-pieces adapted to be inserted into said switch, and when inserted to disconnect the contact-pieces of the switch which are normally in contact and connect the two contact-pieces which are connected to the two sides or branches of the line to the two insulated pieces of the plug, (one piece of the plug to one piece of the switch and the other piece of the plug to the other piece of the switch,) a test-receiving instrument at the central office, and switch-testing devices or means whereby an operator may at will connect said instrument, grounded on one side, on its other side to said third contact-piece connected to said open end of the line, substantially as and for the purpose set forth.

5. In a telephone-exchange system, a metallic circuit-line normally disconnected from the ground at the subscriber's station, one side or branch of which line is normally connected to a ground wire or connection at the central office and the other side or branch of which is open at the central office, and a battery and a calling-annunciator in said ground wire or connection, in combination with a calling generator at the subscriber's station in said line, means for grounding said line at the subscriber's station when the generator is being operated with the generator between that ground-connection and the office ground, a test-receiving instrument, and switch testing devices or means whereby an operator may at will connect said instrument, grounded on one side, on its other side to said open end of the line, substantially as and for the purpose set forth.

6. In a telephone-exchange system, two or more multiple switch-boards, metallic circuit-lines connected thereto, each of said lines being normaliy disconnected from the ground at the subscriber's station, one side or branch of each line being normally connected at the central office to a ground wire or connection, and the other side or branch being normally open at the central office, and a battery in said ground wire or connection, in combination with switching devices or means to temporarily disconnect the branch of said line from its ground wire or connection and to connect the two branches with the two branches of another line for conversation, test-receiving instruments, one at each board, and switch-testing devices or means at each board whereby an operator may at will connect her test-receiving instrument, grounded on one side, on its other side to the open end of any of said metallic circuit-lines, substantially as and for the purpose set forth.

7. In a telephone exchange system, a metallic circuit-line normally disconnected from the ground at the subscriber's station, one side or branch of which is normally grounded at the central office, in combination with a test-receiving instrument at the central office grounded on one side, a switch-testing plug or device to connect said instrument on its other side to the other side or branch of the line, said side or branch being open to the ground, and thereby establish a test-circuit when the line is not switched from the ground of the instrument through the metallic circuit of the line to the normal ground of the line, a battery in said test-circuit, and a switching device containing a pair of contact-points in the circuit of said side or branch of the line which is normally grounded, whereby an operator may at will disconnect the line from its normal ground, substantially as set forth.

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