(No Model.) 2 Sheets—Sheet 1.

# M. G. KELLOGG.

## MULTIPLE SWITCH BOARD.

No. 386,887. Patented July 31, 1888.

Fig. 1a.

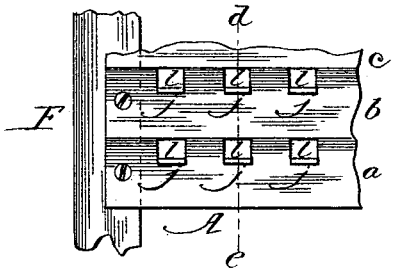



Fig. 1b.

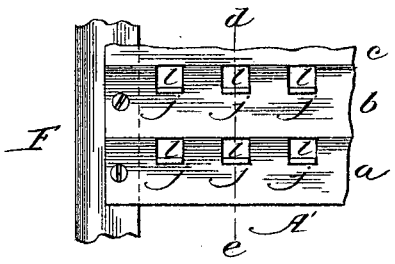
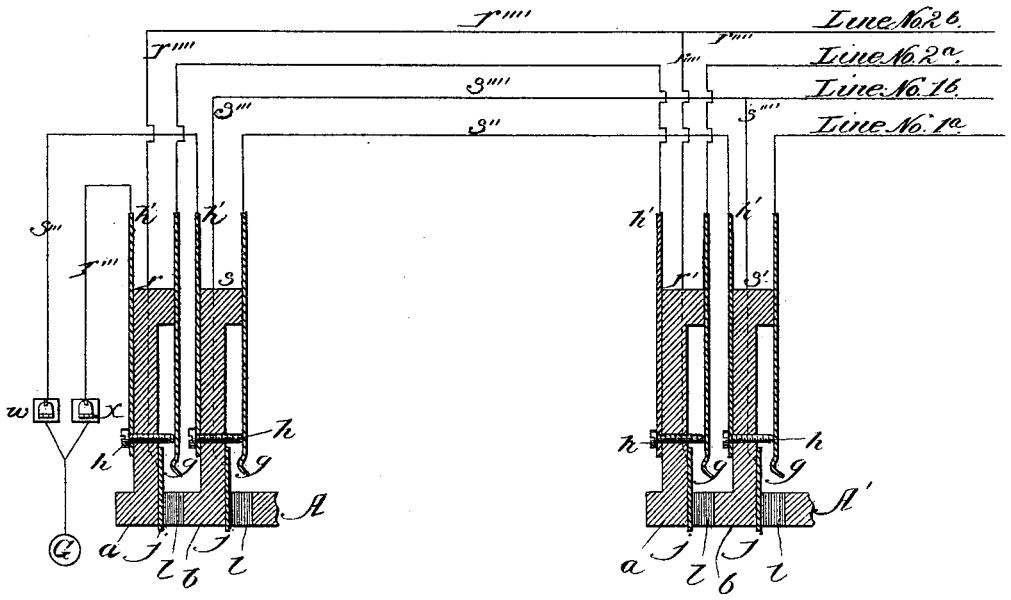



Fig. 2.




Witnesses:

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Frank L. Blanchard

Inventor:

Milo G. Kellogg.

(No Model.) 2 Sheets—Sheet 2.

# M. G. KELLOGG.

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Fig. 3.

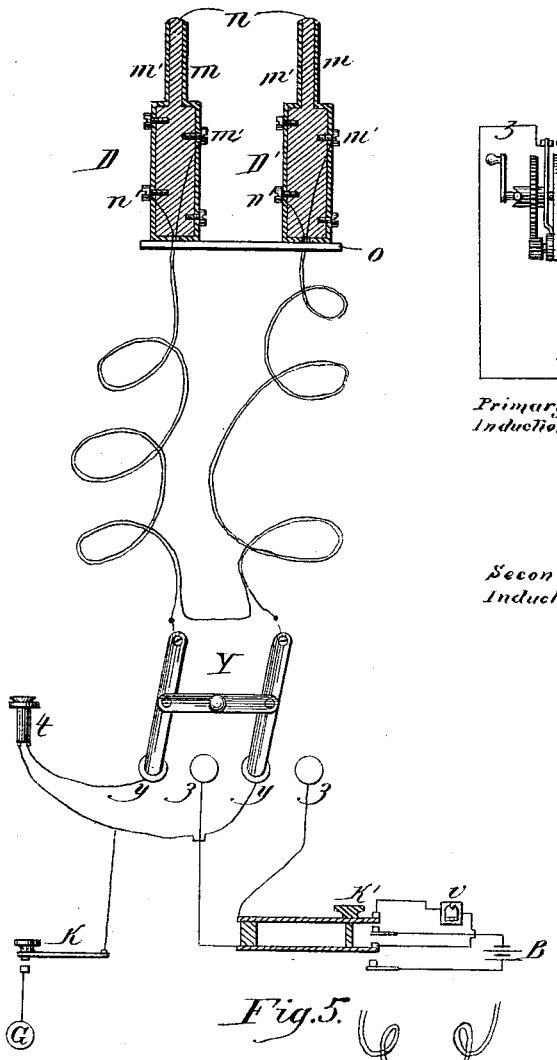



Fig 4.

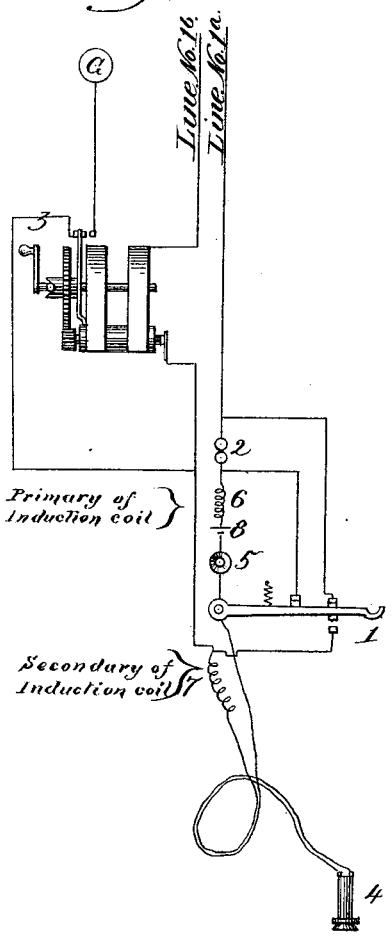
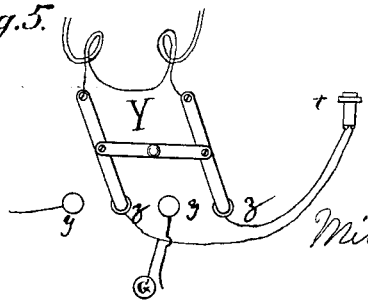



Fig. 5.




Witnesses:

Howard B. Hallock.

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Milo G. Kellogg

# UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF HYDE PARK, ILLINOIS.

## MULTIPLE SWITCH-BOARD.

SPECIFICATION forming part of Letters Patent No. 386,837, dated July 31, 1888.

Application filed August 23, 1887. Serial No. 247,641. (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 I shall hereinafter describe and claim in detail.

It consists, secondly, 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 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 plugs, 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 mentioned above 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 for each board, providing it were connected to the open end of the 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 or pieces 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 subscribers' station apparatus, hereinafter described. Fig. 3 is a diagram of the operator's cord system. Fig. 4 is a diagram of the subscribers' station apparatus, and Fig. 5 is a modification of part of the operator's cord system shown in Fig. 3.

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. $1^b$, 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* 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 switch-plug is inserted into any of the switch-holes it raises the spring in the rear of the hole from the 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 above, may be considered as a spring-jack switch. It is not necessary that the switch-holes should be square, as they may be made to conform to the shapes and arrangement of the parts used.

The circuits and connections of a subscriber's 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 "wire No. $1^a$" and "wire No. $1^b$."

*s* and *s'* are the switches for the two lines on the two boards.

Wire 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 the line-annunciator, and thence to the common ground-wire and ground.

Wire No. $1^b$ is connected to the contact-pieces *j j* of 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 "wire No. $2^a$" and "wire 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 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.

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 strip *o*, which thereby temporarily connects them together. Weights, as is usual, or similar devices, may be used to bring the plugs into contact with the strip and form a good connection.

Y 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 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 or battery. *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 the operator may connect any plug with any switch at her board. Each operator needs only 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 branches off from one of the telephone-cords would connect directly with the ground. Fig. 5 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, 4 is the hand-telephone, 5 is the transmitter, 6 is the primary, 7 is the secondary of the induction-coil, and 8 is the transmitter-battery. These parts may be the usual forms of apparatus, and are connected as shown, or in other known ways, except the calling-generator, which is modified and connected as shown. Wire No. $1^a$ and wire No. $1^b$ (shown in this figure) are two wires of a circuit. 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 reason for this will hereinafter be apparent.

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 this 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 the circuits are substantially as shown and as will produce the results described above. Other automatic devices may be used and modified so as to produce these results. A common key or switch might be used and operated by the hand of the subscriber to ground the line while he is sending in the signal. The generator should be con-

nected so that the temporary ground is made between the normally-open end of the subscriber's line and the armature coil.

It will be noticed that the transmitter-battery is in the line-circuit and that it is closed to the transmitter and to the primary of the induction-coil when the telephone-switch is in position for the telephone to be used. The transmitter-battery also acts as a test-battery for its line, as will hereinafter appear.

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 the line-annunciator at the central office. He then removes his telephone from its switch, and the operator at the central office 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 *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 on 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, through the subscriber's station battery, back to the central office, and to ground. The battery being thus closed through the operator's telephone, she will hear a click in it and will know that the line is not in use. She will then place the plug in the switch, and, moving the levers of the switch Y (corresponding to the pair of plugs used) so that they rest on *z z*, she will press on the key *k′* and temporarily loop her calling-generator into the circuit. When she removes the pressure from the 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 made the test, as above described, the line tested had been switched at another board, it would have been disconnected from the ground and she would not have heard the click in her telephone, as there would not then have been a complete circuit through her telephone and the battery. She would thus have known that the line was busy, and she would not 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.

The subscriber's telephone should be on his switch when his line is not in use, thereby opening the local-battery circuit and shunting the telephone.

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 telephone-line normally open at one end at the central office and normally grounded at the other end at the central office, and there only, in combination with a battery in the circuit of the line at the subscriber's station, a switching device containing a pair of contact points or pieces in the circuit of the line at the central office, adapted to remove the ground from the line when it is switched with another line for conversation, a test-receiving instrument at the central office, and a switch testing-plug or contact-piece connected to one side of the test-receiving instrument, and adapted, at the will of the operator, to connect the test-receiving instrument grounded on one side to the normally open end of the line on the other side, and thereby determine whether the line is switched for conversation.

2. In a telephone-exchange system, two or more switch-boards at the central office, and metallic circuit-lines connected to them, each line being normally open at one end and connected at that end to each of the switch-boards and normally grounded at its other end at the central office, and there only, and each line having a battery in its circuit, in combination with switching devices, one for each line at each board, each containing a pair of contact points or pieces in the circuit of the line, adapted to remove the ground from its line when the line is switched for conversation, test-receiving instruments, one at each board, and switch-testing plug or contact-piece connected to one side of the test-receiving instrument at each board, whereby the operator at any board may connect her test-receiving instrument, grounded on one side, to the normally-open end of any line on its other side, and determine whether the line is switched for conversation.

3. In a telephone exchange system, a metallic-circuit telephone-line normally open at one end at the central office and normally grounded at the other end, and there only, and having a battery in its circuit, in combination with a generator in the circuit of the line at the subscriber's station, an annunciator in the ground wire or connection at the central office, a switching device adapted to ground said line at the subscriber's station between its normally-open end and the generator when the generator is being operated, a switching device containing a pair of contact points or

pieces in the circuit of the line at the central office adapted to disconnect the line from the ground when it is switched for conversation, a test-receiving instrument at the central office, and a switch-testing plug or contact-piece connected to one side of the test-receiving instrument adapted, at the will of the operator, to connect the test-receiving instrument, grounded on one side, to the normally-open end of the line on the other side, substantially as and for the purpose set forth.

4. In a telephone-exchange system, a metallic-circuit telephone-line normally grounded at the central office and having a calling-annunciator in its ground wire or connection, and a switching device containing a pair of contact points or pieces in the circuit of the line at the central office adapted to remove said ground and to connect said line with another line in metallic circuit with a clearing-out annunciator in the circuit, in combination with a calling-generator at the subscriber's station, and a switching device having two pairs of contact-points, said switching device being operated in one direction by a spring, and in the other direction by the force which actuates the generator, one pair of said points switching the generator, when it is being operated, into circuit with the line, and the other pair then grounding the line with the generator between this ground and the office ground, the subscriber being thereby enabled to operate the calling-annunciator when it is connected to his line and the clearing-out annunciator when it is looped into the metallic circuit, substantially as set forth.

5. In a telephone-exchange system, a metallic-circuit telephone-line grounded on one of its sides or branches at the central office, and grounded there only, in combination with a battery in the circuit of the line at the subscriber's station, a switching device containing a pair of contact points or pieces in the circuit of the line at the central office adapted to disconnect said side or branch from the ground while the line is switched with another line for conversation, a test-receiving instrument and switch-testing plug or contact-piece connected to one side of the test-receiving instrument adapted, at the will of the operator, to connect said test-receiving instrument, grounded on one side, on its other side to the other branch of the line open to the ground, substantially as and for the purpose set forth.

6. In a telephone-exchange system, a metallic-circuit telephone-line grounded on one of its sides or branches at the central office and disconnected from the ground at the subscriber's station, in combination with a battery in the circuit of the line, a switching device containing a pair of contact points or pieces in the circuit of the line at the central office adapted to disconnect said side or branch from the ground while the line is switched with another line for conversation, a test-receiving instrument, and a switch-testing plug or contact-piece connected to one side of the test-receiving instrument adapted, at the will of the operator, to connect said test-receiving instrument, said instrument being grounded on its other side, and said switch-testing plug being adapted, at the will of the operator, to connect with the other branch of the line, which is disconnected from the earth, substantially as set forth.

7. In a telephone-exchange system, a metallic-circuit line normally disconnected from the ground at the subscriber's station and normally connected on one of its sides or branches with a ground wire or connection at the central office, a calling-annunciator in said ground wire or connection, and switching devices or means containing a pair of contact points or pieces in the said side or branch, and another contact point or piece connected to the other side or branch at the central office adapted to temporarily disconnect said line from said ground wire or connection and to connect it in metallic circuit with another line, in combination with a calling-generator at the subscriber's station in said line and switching devices or means containing a pair of contact-points normally open, one of which is connected with the ground and the other one to the line between the generator and the normally-open end of the line, whereby the subscriber, while operating said generator, grounds said line with the generator between the ground and said office ground wire or connection, substantially as and for the purpose set forth.

8. In a telephone-exchange system, a metallic-circuit telephone-line normally disconnected from the earth at the subscriber's station and normally grounded on one side only at the central office and a switching device containing a pair of contact-points in the circuit of the line at the central office, in combination with a generator in the circuit of the line at the subscriber's station while operated, a switching device at the subscriber's station containing a pair of contact-points normally open, and an annunciator in the circuit of the line at the central office, said normally-open contact-points being closed while the generator is operated, one of them being connected to the subscriber's ground and the other to the line with the generator and annunciator between it and the office ground, substantially as set forth.

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Witnesses:
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CALVIN DE WOLF.