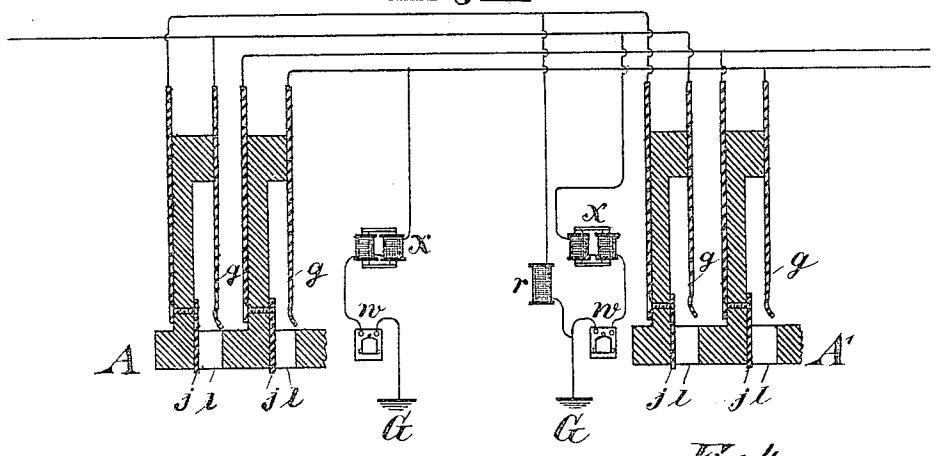
No. 817,781. PATENTED APR. 17, 1906.

M. G. KELLOGG.

MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES.

APPLICATION FILED NOV. 30, 1891.

Fig. 1.



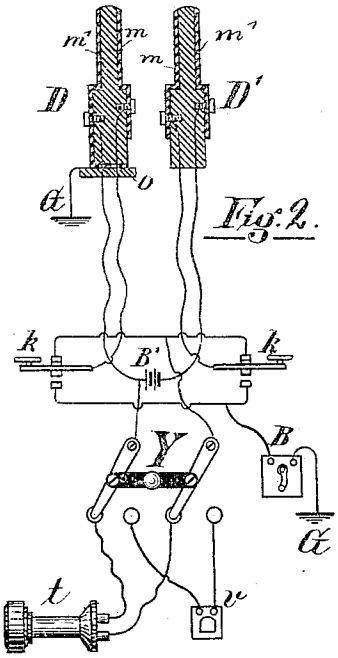




Fig. 2.

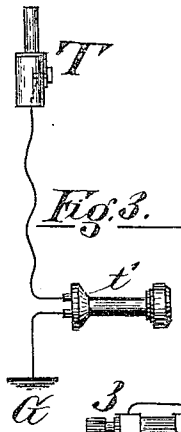
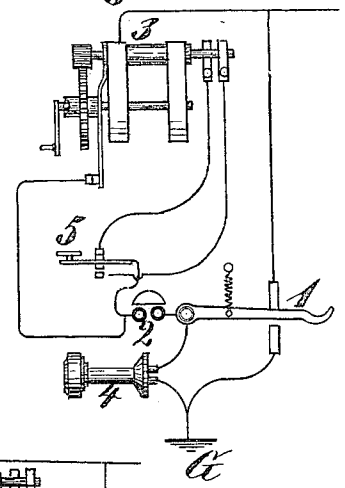



Fig. 3.

Fig. 4.



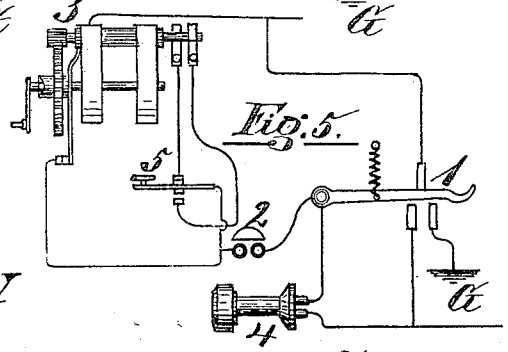
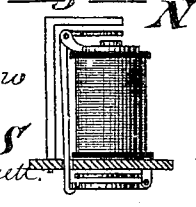




Fig. 5.

Fig. 6.

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# UNITED STATES PATENT OFFICE.

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## MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES.

No. 817,781. Specification of Letters Patent. Patented April 17, 1906.

Application filed November 30, 1891. Serial No. 413,608.

*To all whom it may concern:*

Be it known that I, MILO G. KELLOGG, of Chicago, in the county of Cook and State of Illinois, temporarily residing at Geneva, in the Republic of Switzerland, 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 especially to a telephone-exchange system in which part of the lines are ground-circuit lines and part of the lines are metallic-circuit lines in which each line is permanently grounded at the central office through its annunciator; and it consists of a system of calling, testing, switching, and clearing out for such an exchange, which I shall describe and claim in detail.

Certain features of the invention, which I shall claim, are applicable to exchanges in which all the lines are metallic-circuit lines and certain features are applicable to exchanges in which all the lines are ground-circuit lines. Certain features are, moreover, broad enough to include systems in which the lines are not permanently grounded at the central office.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram with sections of two switchboards to which the same lines are connected, with two lines connected to the same and their central-office apparatus. Fig. 2 shows an operator's cord system adapted to be used at any board. Fig. 3 shows an operator's test system adapted to be used at any board. Fig. 4 shows a subscriber's station apparatus for each ground-circuit line. Fig. 5 shows a subscriber's station apparatus for each metallic-circuit line. Fig. 6 shows a polarized annunciator which may be used for each line.

In Fig. 1, A A′ are sectional views of sections of two switchboards. Each board has a switch for each line. Each switch has two contact-pieces insulated from each other (except by the circuit connections) and a switch hole adapted to receive a loop switch-plug at its board. The contact-pieces of the switch are so placed and arranged that when a loop switch-plug (shown in Fig. 2 and marked D D′) is inserted into the switch-hole the two contact-pieces of the plug form connection with the two contact-pieces of the switch, respectively. In the drawings one of the contact-pieces of each switch is a spring and is marked *g*, and the other contact-piece is placed along the switch-hole and is marked *j*. The contact-pieces are mounted on rubber strips of the shape substantially as shown, through the fronts of which are the holes *l l*. Other forms of switches may be used which have two contact-pieces insulated from each other and adapted to receive loop switch-plugs and form connection between their two contact-pieces and the two contact-pieces of the plug.

*w w* are line-annunciators, and *x x* retardation-coils, one annunciator and one retardation-coil for each line.

The connections of the lines in the central office are as follows: One side or branch of each metallic-circuit line is connected to one contact-piece of each of the switches of the line—say *g g*—and the other side or branch of the line is connected to the other contact-piece of each switch—say *j j*. The first-mentioned side of the line is grounded through the annunciator and retardation-coil of the line. Each ground-circuit line is connected to the contact-pieces *g g* of its switches and is grounded through its annunciator and retardation-coil. The contact-pieces *j j* of the switches of a ground-circuit line are connected together and grounded through a resistance-coil. There is one coil for each of such lines, and the one shown in Fig. 1 is marked *r*.

One metallic-circuit and one ground-circuit line are shown in Fig. 1, and they are connected as above described.

In Fig. 2, D D′ are a pair of loop switch-plugs, each plug adapted to be inserted into each switch at its board and when inserted to form connections substantially as has been described. The two contact-pieces of one plug are connected with the two contact-pieces of the other plug, respectively, by two flexible switch-conductors. *t* is the operator's telephone, B a calling-generator, *v* a clearing-out annunciator, Y a looping-in switch, B′ a test-battery, and *k k* two calling-keys. Each pair of plugs has one annunciator, one switch, one test-battery, and two keys. One calling-generator will answer for

the exchange. The two keys *k k* have each a lever, a point against which the lever normally presses, and another point against which the lever comes in contact when it is pressed away from the first point. The two contact-pieces of each plug are marked *m m'*. The test-battery is placed in the flexible conductor which connects the contacts *m' m'* of the plugs. The two contacts *m m* are connected to the two key-levers. The points with which these levers are normally in contact are connected together by a circuit connection, and this connection is connected to one of the levers of the switch Y. The two other points of the keys are grounded through the calling-generator. The other lever of the switch is connected with the conductor which contains the battery B'. One pair of the contact-bolts of the switch Y are connected together through the operator's telephone and the other pair are connected together through the clearing-out annunciator.

Only one pair of plugs with their special apparatus is shown. Other pairs may be added to the operator's cord system, substantially as shown and in a way which will be apparent to those skilled in the art.

In the operator's test system (shown in Fig. 3) T is the test-plug, and *t'* the test receiving instrument. The plug is connected to a flexible conductor and is adapted to be brought for testing into connection with contact-piece *j* of each switch at its board. It is grounded through its test receiving instrument. Each operator has a cord system and a test system suitably arranged at her board.

The switch-plugs should be inserted into the line-switches in such a direction that contact *m* forms connection with contact *g* of the switch and *m'* forms connection with contact *j* of the switch.

In the subscriber's station apparatuses shown in Figs. 4 and 5 the magneto calling-generator is constructed with the usual automatic device, whereby it is shunted or switched from the line-circuit while not operated. The insulated piece on the shaft of the generator-armature, to which is connected one end of the armature-wire and which conducts the generated current to the line through the stationary spring-contacts provided for it, is a half-circle, the remaining part of the circle being an insulation. I provide two stationary contact-springs, as shown, bearing on diametrically opposite parts of the circle of the shaft of which said insulated contact-piece is a part. It is well known that when magneto calling-generators are operated a current of one polarity is generated during one half of the revolution of the armature and a current of the other polarity is generated during the other half of the revolution of the armature.

In the station apparatus shown in Figs. 4 and 5, 1 is the telephone-switch, 2 the signal-receiving bell, 3 the calling-generator, 4 the telephone, and 5 a clearing-out key. The key has a lever which is normally in contact with a contact-point and another point against which the lever comes into contact when it is pressed away from the first point. In Fig. 4 the ground-circuit line passes to the frame of the generator. One of the contact-springs of the generator is connected to one of the points of the key and the other spring is connected to the other point. The lever of the key is connected through the signal-receiving bell to the lever of the switch. The lever of the switch is grounded through the telephone. The automatic device of the generator shunts the generator and the key while the generator is not operated. The switch has contact-points and connections by which the telephone is short-circuited while the telephone is on the switch and the signal-bell, generator, and key are short-circuited while the telephone is off the switch. The connections in Fig. 5 are the same as described above for Fig. 4, except that instead of the ground connection through the telephone the circuit passes to one branch of the metallic-circuit line. In Fig. 5 there is a pair of contacts on the switch by which the line-circuit is grounded while the telephone is on the switch. The apparatus should be connected into the line-circuit, so that the armature-coil and signal-receiving bell are between this ground connection and the permanent ground connection of the line in the central office. The operator's calling-generator should preferably send only one polarity of current to line in calling and the polarized annunciators of the lines *w w* be so connected as not to be operated by that polarity of current. The contact-springs of the subscriber's calling-generators should be so placed in relation to the armatures that one of them takes a current of one polarity and the other a current of the other polarity.

The polarized annunciator shown in Fig. 6 is substantially a modification of the non-polarized annunciator most generally used for telephone-exchanges and shown and described in detail in the patent of James C. Warner, No. 266,405, and dated October 24, 1882. The modification consists, essentially, in the employment of a permanent magnet N S, attached at one end to the iron plate which forms the pole-piece of the electromagnet of the annunciator and which therefore charges the cores of the electromagnet with one polarity of magnetism. The permanent magnet is bent so that its other end is in close juxtaposition to the armature of the annunciator and charges the armature by induction. It is well known that when a current is sent through a polarized annunciator of the polarity not to operate it there is no attraction whatever between the electromagnet and the armature of the annunciator,

and therefore there is then no tendency to release the annunciator-drop, so that it may fall and indicate a call. On the other hand, when such a current is passing through the annunciator there is a repulsion between the electromagnet and the armature which, in fact, then positively holds down the catch of the annunciator and positively locks and prevents the release of the drop.

The operation of the system is as follows: When a subscriber wishes a connection, he sends a current from his calling-generator of the polarity which will operate the line-annunciator. The operator on observing the call places one of her plugs D′ in the switch of the line, and the switch Y, which belongs to the plug, being in position, so that her telephone bridges across the circuit of the two flexible conductors of the plug her telephone is in complete circuit with the line and she finds out by conversation what line is wanted. If the line is a metallic-circuit line, the circuit is from both sides of the telephone to both sides of the line. If it is a ground-circuit line, the circuit is from the line to one side of the telephone and through the telephone to ground through the resistance-coil connected to the contact-piece *j* of the line-switch. When the operator finds out by conversation what line is wanted, she tests the line, as will hereinafter be indicated. If the line tests "free" or not in use, she places the other plug of the pair in the switch of the line, and the two lines are thereby connected in a circuit which is bridged or cross-connected by the operator's telephone. If the two lines are metallic-circuit lines, the circuit into which they are connected is a complete metallic circuit, and the telephone bridges the circuit. If the two lines are ground-circuit lines, the circuit is from ground of one line through the circuit of the two lines to the ground of the other line, and the telephone is in a bridge or third-leg connection from the circuit to ground through the two resistance-coils *r r* of the lines. If one of the lines is a ground-circuit line and the other is a metallic-circuit line, the circuit is from ground through the ground-circuit line, thence through the metallic-circuit line and to ground through the resistance-coil of the ground-circuit line, and the circuit is bridged by the telephone. The operator calls the line wanted by operating the key *k* of the lever connected with the contact-piece *m* of the plug which is in the switch of the line. A calling-current then goes from ground to the line and through the subscriber's bell to ground at his station and rings the bell. She then moves the switch Y so that the clearing-out annunciator of the pair of plugs is in the bridge connection in place of the telephone. When two lines are connected together as described, the circuit is grounded through the ground connections of the two lines which contain their line-annunciators and retardation-coils. On account of the resistance and retardation of the annunciators and coils these ground connections will not affect conversation which may be passing over the circuit. The clearing-out annunciators may be non-polarized annunciators. When a subscriber desires to send a clearing-out signal, he sends a current of the polarity which does not operate his line-annunciator. If his line is a ground-circuit line, the current goes to ground through the clearing-out annunciator connected with the line and operates the annunciator. If his line is a metallic-circuit line, the current goes through his metallic circuit and the clearing-out annunciator and operates the annunciator. Part of the current will go to ground through the line-annunciators of the two lines; but on account of the polarity of the current neither annunciator will indicate a call.

When the subscriber sends the clearing-out signal, as above described, and part of the current goes through the line-annunciators, there is on account of the polarity of the current and the construction of the annunciators no attraction whatever between the line-annunciator magnets and their armatures, and consequently there is no tendency or force whatever exerted to release the drop. There is, on the other hand, a repulsion between the two, which then acts to positively lock and prevent the release of the drop. The drop is therefore positively prevented from being operated when the clearing-out current is sent and is, in fact, locked, so as to be prevented from falling. In other systems of exchange operation in which the line-annunciators of two connected lines are in circuit with a calling-generator operated to send a clearing-out signal there is an attraction between the line-annunciator magnets and their armature, and consequently there is a tendency to release the drop, which is only prevented from being operated or released from the fact that the current is not strong enough to furnish sufficient attraction to move the armature and release the drop. In such a system the line-drops are prevented from being operated only by a margin of current or force which may at times be difficult to obtain and be more or less unreliable, while in my system the line-annunciators are positively prevented from being operated by and the drops are, in fact, electrically locked to the clearing-out current sent through the annunciators however strong the current may be. In like manner when the operator sends a calling-current through a subscriber's line and part of the same passes through his line-annunciator the line-annunciator is by the polarity of the current and its own construction positively prevented from being operated or is practically locked to the calling-current

whatever may be the strength of the current, and the preventing of the line-drop from being operated does not depend on the current not being sufficient to attract and move the armature of the annunciator. The advantages of my system are especially in its reliability and its not requiring very high resistance in the circuit of the line-annunciator connections.

The annunciators and generators may be so connected that the subscriber sends his call by operating his generator when his key 5 is not depressed and sends a clearing-out signal by operating the generator while the key is depressed, or the reverse may be the operation.

The test system is as follows: When the operator at any board desires to test a line, she places her test-plug T on the contact-piece *j* of the line. If the line tested is switched, there will be a complete circuit from ground through her test-receiving instrument to the test-plug, thence to the contact *j*, where the line is tested, thence to contact *j* of the switch in which is the switching-plug, thence to contact *m'* of that plug and through the test-battery in circuit with the plugs to the contact *m'* of the other plug of the pair, and thence to the ground. If the last-mentioned plug is a plug D, resting on a ground-plate *o*, (shown in Fig. 2,) the connection to ground is through this plate. If the plug is in the switch of a ground-circuit line, there is a ground connection through the resistance-coil *r* of the line. If it is in the switch of a metallic-circuit line, there is a ground connection through the annunciator and retardation-coil of the line. In any case therefore when the line is switched there will be a complete circuit on testing, which includes a battery and test-receiving instrument, and the instrument will sound. If the line is not switched, no such complete circuit is established and the instrument will not sound. The operator can therefore determine on testing whether or not the line is in use.

Instead of the annunciator *w* and retardation-coil *x* for each line an annunciator may be employed which has high resistance and high retardation to telephone-currents.

The general system of calling and clearing out by the subscriber herein shown is claimed in my application Serial No. 413,605, filed November 30, 1891.

I claim as my invention—

1. In a telephone-exchange system, a metallic-circuit and a ground-circuit line connected together in a complete circuit for conversation from the ground of the subscriber's ground-circuit line through such line and thence through the metallic-circuit line to ground at the central office, two circuit connections of high retardation, one for each line, through both of which respectively said complete circuit is grounded at the central office and the line-annunciators forming part of said circuit connection, substantially as set forth.

2. In a telephone-exchange system, a metallic-circuit and a ground-circuit line connected together in a complete circuit for conversation from the subscriber's ground of the ground-circuit line through such line and thence through the metallic-circuit line to ground at the central office, and the annunciators of the two lines through both of which respectively said complete circuit is grounded at the central office, in combination with a test-battery in said complete circuit and a test-receiving instrument at each board grounded on one side and connected on its other side to a plug or device adapted to be brought for testing into connection with each line, substantially as set forth.

3. In a telephone-exchange system, a metallic-circuit and a ground-circuit line connected together in a complete circuit for conversation from the subscriber's ground of the ground-circuit line through such line thence through the metallic-circuit line to ground at the central office, and retardation-coils, one for each line, through which said complete circuit is grounded at the central office, in combination with a test-battery in said complete circuit and a test-receiving instrument at each board grounded on one side and connected on its other side to a plug or device adapted to be brought for testing into connection with each line, substantially as set forth.

4. In a telephone-exchange system, a metallic-circuit and a ground-circuit line connected together in a complete circuit for conversation from the subscriber's ground of the ground-circuit line through such line and thence through the metallic-circuit line to ground at the central office, and retardation-coils and annunciators, one of each for each line through which said complete circuit is grounded at the central office, in combination with a test-battery in said complete circuit, and a test-receiving instrument at each board grounded on one side and connected on its other side to a plug or device adapted to be brought for testing into connection with each circuit, substantially as set forth.

5. In a telephone-exchange, telephone-lines each permanently grounded at the central office and a test circuit or connection for each line open to its line and grounded, in combination with apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are connected together for conversation, substantially as set forth.

6. In a telephone-exchange system, telephone-lines each permanently grounded at the central office and a test circuit or connection for each line open to the line and grounded through a resistance-coil, in combination

with apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are connected together for conversation, substantially as set forth.

7. In a telephone-exchange system, telephone-lines, each permanently grounded at the central office and a test circuit or connection for each line open to the line and grounded, in combination with apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are connected together, and a test-receiving instrument grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with any of said test-circuits, substantially as set forth.

8. In a telephone-exchange system, telephone-lines each permanently grounded at the central office, a test circuit or connection for each line open to its line and connected to one side of a test-receiving instrument, in combination with apparatus and connections by which any two of said test-circuits are connected together through a test-battery, and a plug or device connected to the other side of said test-receiving instrument and adapted to be brought into connection with any of said test-circuits, substantially as set forth.

9. In a telephone-exchange system, telephone-lines each permanently grounded at the central office, and a test wire or circuit for each line open to the line and connected through an individual resistance-coil to one side of a test-receiving instrument, in combination with apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are switched for conversation, and a plug or device connected to the other side of said test-receiving instrument and adapted to be brought into connection with any of said test-circuits, substantially as set forth.

10. In a telephone-exchange system, multiple switchboards, telephone-lines connected to the same and permanently grounded at the central office, switch apparatus by which any two of said lines may be connected together for conversation and test wires or circuits, one for each line, open to the line, extending to all the boards and grounded, in combination with apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are switched together for conversation, and test-receiving instruments one at each board, each instrument grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with any of said test-circuits, substantially as set forth.

11. In a telephone-exchange system, multiple switchboards, telephone-lines connected to the same and permanently grounded at the central office, switch apparatus by which any two of said lines may be connected together for conversation and test wires or circuits, one for each line, each open to its line, extending to all the boards and grounded through an individual resistance-coil, in combination with apparatus and connections by which any two of said test-circuits are connected together for conversation, and test-receiving instruments, one at each board, each instrument grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with any of said test-circuits, substantially as set forth.

12. In a telephone-exchange system, multiple switchboards, telephone-lines connected to the same and permanently grounded at the central office, switch apparatus by which any two of said lines may be connected together for conversation and test-receiving instruments, one at each board, in combination with test wires or circuits one for each line, each open to the line, extending to all the boards and connected to one side of each of said test-receiving instruments, apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are switched together for conversation, and plugs or devices, one for each test-receiving instrument, connected to the other side of the instrument and adapted to be brought into connection with any of said test-circuits, substantially as set forth.

13. In a telephone-exchange system, multiple switchboards, telephone-lines connected to the same and permanently grounded at the central office, switch apparatus by which any two of said lines may be connected together for conversation, and test-receiving instruments, one at each board, in combination with test wires or circuits one for each line, each open to the line, extending to all the boards and connected through an individual resistance-coil to one side of each of said test-receiving instruments, apparatus and connections by which any two of said test-circuits are connected together through a test-battery when their lines are connected together for conversation and plugs or devices one for each test-receiving instrument, each connected to the other side of its instrument and adapted to be brought into connection with any of said test-circuits, substantially as set forth.

14. In a telephone-exchange system, telephone-lines a ground-connection for each line at the central office permanently connected to the line and a test circuit or connection for each line open to the line and grounded, in combination with test-battery through

which each test-circuit is grounded while its line is switched for conversation, substantially as set forth.

15. In a telephone-exchange system, telephone-lines a ground connection for each line at the central office permanently connected to the line and a test circuit or connection for each line open to the line and grounded through a resistance-coil, in combination with test-battery through which each test-circuit is grounded while its line is switched for conversation, substantially as set forth.

16. In a telephone-exchange system, telephone-lines each permanently grounded at the central office and a test circuit or connection for each line open to the line and grounded, in combination with test-battery through which each test-circuit is grounded while its line is switched for conversation, and test-receiving instruments, one at each board, each grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with each of said test-circuits, substantially as set forth.

17. In a telephone-exchange system, telephone-lines each permanently grounded at the central office, and a test circuit or connection for each line open to the line and grounded through a resistance-coil, in combination with test-battery through which each test-circuit is grounded while its line is switched for conversation and test-receiving instruments, one at each board, each grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with each of said test-circuits, substantially as set forth.

18. In a telephone-exchange system, multiple switchboards, telephone-lines connected to the same and permanently grounded at the central office, switch apparatus by which any two of said lines may be connected together for conversation and test wires or circuits, one for each line, open to the line, extending to all the boards and grounded, in combination with apparatus and connections by which any of said test-circuits is grounded through a test-battery when its line is switched together for conversation, and test-receiving instruments, one at each board, each instrument grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with any of said test-circuits, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
ANNA KELLOGG,
LEROY D. KELLOGG.