(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,312. Patented Oct. 26, 1897.

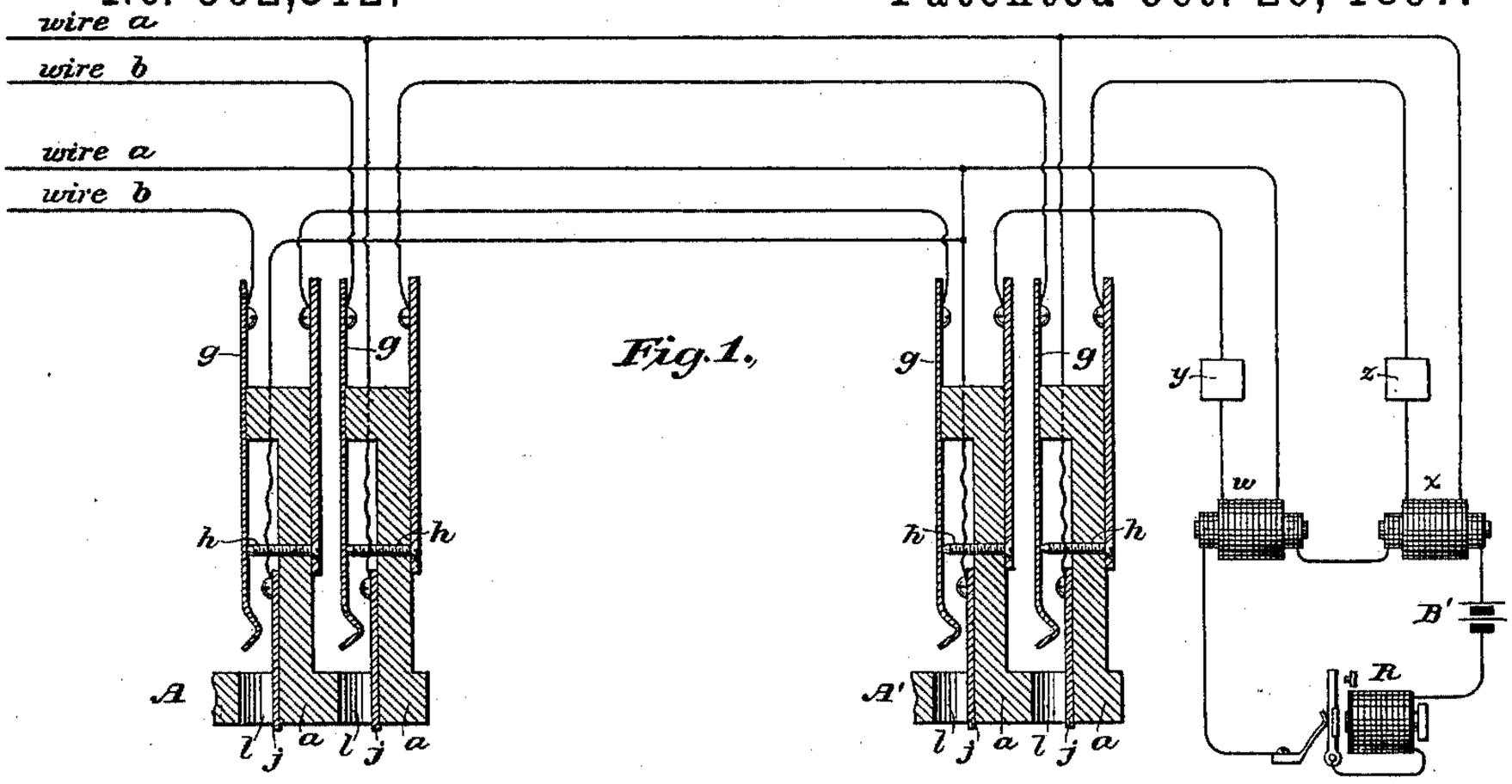

Fig. 1.

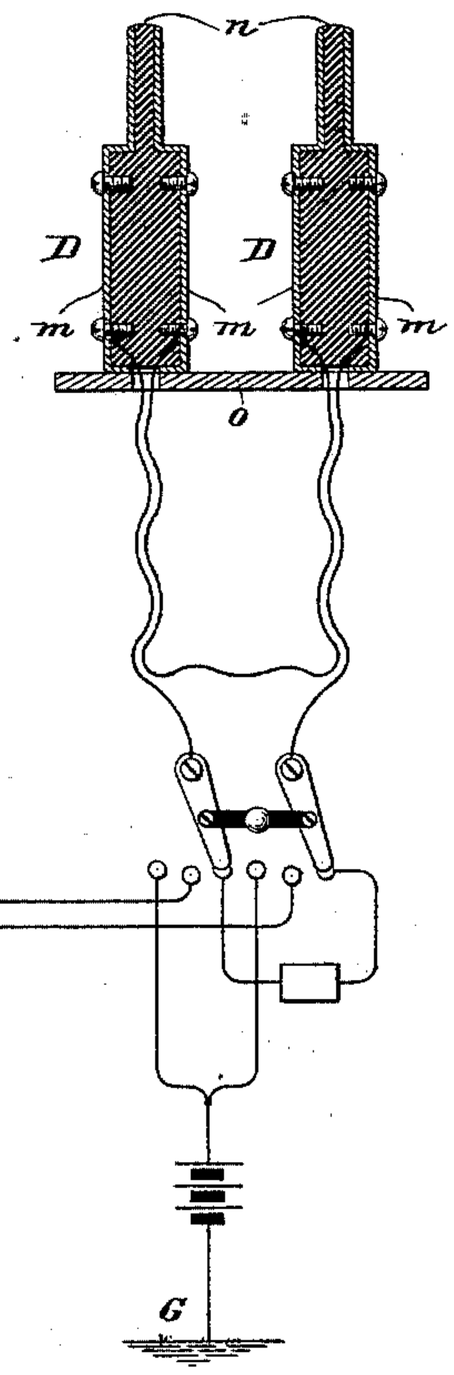

Fig. 2.

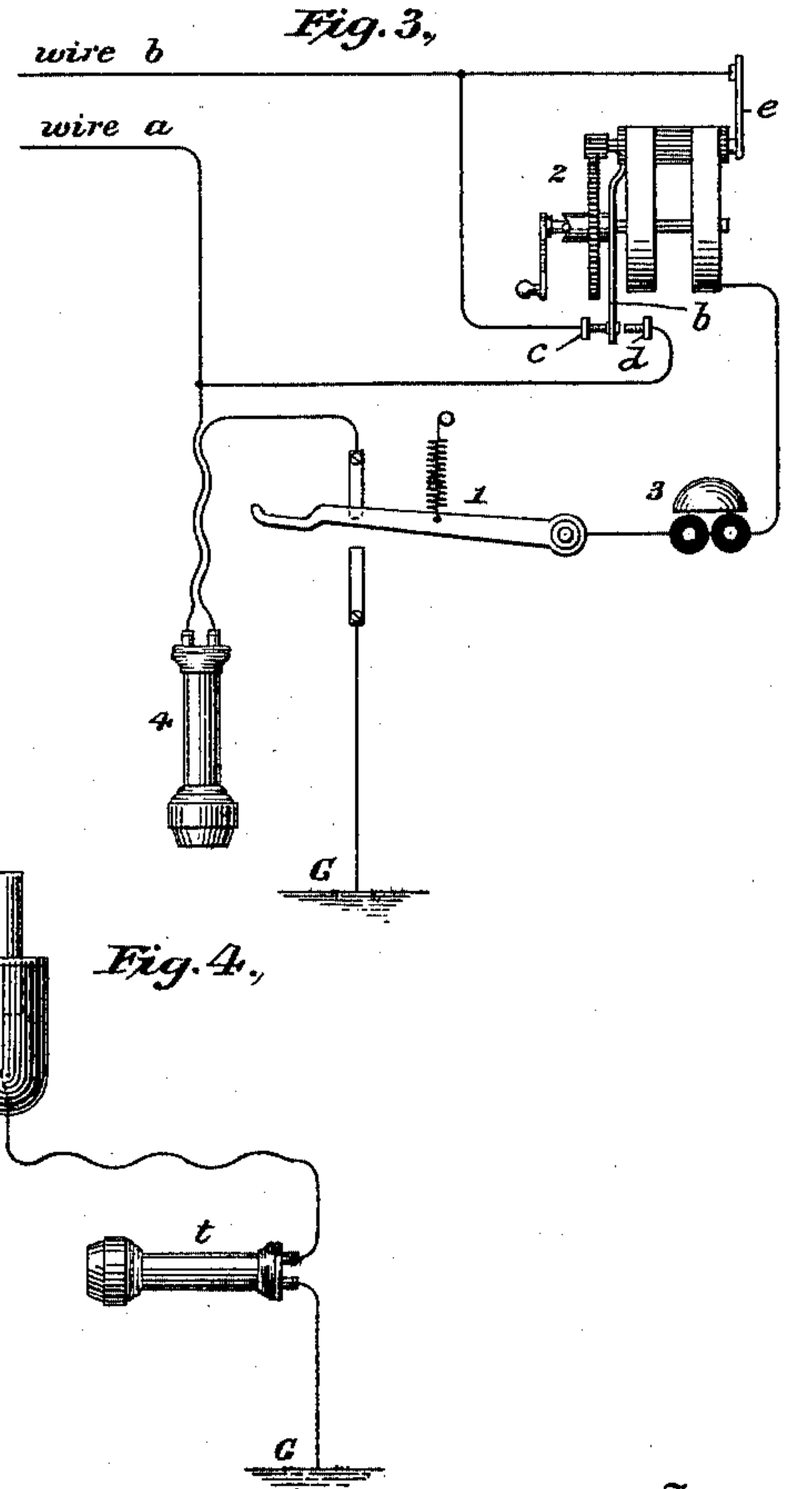

Fig. 3.

Fig. 4.

Witnesses
Geo. W. Breck
C. E. Ashley

Inventor
Milo G. Kellogg
By his Attorneys
Baldwin, Davidson & Wright

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. 592,312, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,014. (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 metallic-circuit telephone-exchange system; and it consists in a system of calling, switching, and testing any line to determine whether it is in use.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram illustrating the main-line central-office apparatus and circuits and the test apparatus and circuits connected therewith. Fig. 2 shows a diagram of an operator's cord system for receiving and answering calls, switching, and clearing-out subscribers' lines; Fig. 3 shows a diagram of the subscriber's-station apparatus. Fig. 4 shows an operator's test system, including a test-plug with cord, test-receiving instrument, and connections.

In Fig. 1, A is a sectional view of a section of one switchboard, and A′ is a sectional view of a section of another switchboard to which the same lines are connected. I place as many boards in the central office as are found necessary or desirable in order to properly answer the calls and make the necessary connections. On each board is a spring-jack or similar switch for each line. Each switch has a contact-spring which normally bears on an insulated contact-point and has a contact-piece insulated from the rest, (except by the circuit connections,) and is adapted to receive a loop-switch plug, and when a plug is inserted to disconnect the spring from the contact-point (on which it normally rests) and connect the two contact-pieces of the plug with the spring and said insulated contact-piece, respectively. In the figure, *g g* represent the springs of the different switches, *h h* the contact-points on which the springs normally bear, and *j j* the insulated contact-pieces of the switches.

l l are the switch-holes.

a a are the rubber strips, on which the switch parts are mounted, as shown, and through the fronts of which are the switch-holes *l l*. These holes are adapted to receive the switch-plugs, (shown in Fig. 2 and marked D D,) and when the plugs are inserted in the switches they operate them, as above described. The insulated contact-pieces *j j* should be so placed that a test-plug or similar testing device may be readily connected with them.

w and *x* are induction-coils, one for each line.

R is an electric rheotome, and B′ is a test-battery.

y and *z* are two line-annunciators.

The connection of each main line to the central-office switchboards and apparatus is as follows: One of the branches of the line, say "wire *a*," as indicated in the figure, is connected to all the contact-pieces *j j* of its switches on the different boards. The other branch of the line, say "wire *b*," as indicated, passes successively through the pairs of contact-points formed by the spring-levers and their contact-points of its switches on the different boards, passing in each case to the spring first, as shown. This wire, after passing from the last contact-point of the switch farthest distant from the subscriber's station, is connected by a circuit-wire to wire *a* of the subscriber's circuit. In this circuit-wire thus connecting the two branches of the line I place the line-annunciator and one of the coils of the induction-coil of the line. The other coils of the induction-coils of the lines are in a circuit (or circuits) in which is a constantly-acting rheotome and a battery.

Fig. 1 shows the connections of the lines, the switches, the annunciators, the induction-coils, the rheotome, and the battery, as above described.

In the subscriber's-station apparatus shown in Fig. 3, 1 is the telephone, 2 is the calling-generator, 3 is the signal-bell, and 4 is the subscriber's telephone. G is a ground connection. The circuits and contact-points of the apparatus are substantially as shown.

The generator has an automatic device which is a modification of a device very generally used in magneto-generators for telephone-calls, the modification consisting, essentially, in the number of contacts and the

arrangement of circuits. The hub of the driving-wheel of the generator has a V-shaped attachment which engages with a pin in the driving or crank shaft. The spring *b* normally or when the generator is not in operation presses against contact-point *c*. When the generator is being operated, the pin, acting on the V arrangement, presses the driving-wheel toward the generator-magnets, and that carries the spring *b* away from point *c* and into contact with point *d*.

e is a contact-spring which remains in contact with an insulated piece on the armature-shaft, to which one end of the armature-coil is connected. The other end of the coil and also spring *b* are connected to the frame of the generator. The circuit of one side or branch of a line (marked wire *b*) is to spring *e*, and thence through the armature-coil and the frame of the generator to the signal-receiving bell 3, and thence to the lever of the switch 1. Contact-point *c* is connected to wire *b* before the wire passes to the generator-armature. The other side or branch of the line (marked wire *a*) passes through the telephone to the upper contact-point of the telephone-switch and is connected before it passes to the telephone to contact-point *d* of the generator. The lower contact-point of the telephone-switch is connected to the ground. It will be seen from the construction of the apparatus as shown and described that when the subscriber's telephone is on the switch and the generator is not being operated the two sides or branches of the line are open to each other at the subscriber's station and wire *b* is grounded through the contact between the lever and the lower contact of the switch and has the signal-bell 3 in its circuit. The generator 2 is also in its circuit, but is short-circuited or shunted by the contact between *b* and *c*. It will also be seen that when the generator is being operated the two sides or branches of the line are connected together by the closing of the contacts *b d* and the shunt or short circuit of the generator is opened by the opening of the contacts *b c;* also that when the telephone is removed from the switch the switch-lever will come in contact with the upper contact-point of the switch, removing the ground connection of wire *b* and closing the two sides or branches of the line to each other with the subscriber's telephone included in their circuit.

Fig. 2 shows an operator's cord system with one pair of loop-switch plugs and their double cords, looping-in switch, and clearing-out annunciator, and her telephone, calling-generator, and the circuits. D D are the switch-plugs. *n n* are their rubber insulation, and *m m* are their contact-pieces. The method of operating the system in connection with the switchboards and line apparatus shown will be apparent to those skilled in the art. G is a ground connection. It will be noticed that the calling generator or battery is connected to the ground and that the operator on connecting the generator into a line-circuit establishes a ground-circuit. If the subscriber's telephone is on his switch, the calling-current will pass through the ground-circuit at his station, and a complete circuit being established the subscriber's signal-bell will ring.

The operator's test system shown in Fig. 4 consists, essentially, of a wire with a test receiving instrument (preferably a receiving-telephone) in its circuit, said wire being grounded at one end (at G) and terminating at its other end in a flexible conducting-cord with a test-plug attached, adapted at the will of the operator to be brought into connection with any switch contact-piece *j j* at her board. In the figure, T is the test plug, and *t* is the test receiving instrument.

The operation of the system is as follows: The subscriber who desires to make a call to the central office operates his calling-generator. His line circuit, which is normally open at the central office, is automatically closed by the automatic device of the generator, and the generator and the line-annunciator being then on closed circuit with each other and current being generated will operate the annunciator. The subscriber then removes his telephone from its switch, thus closing the line-circuit through his telephone, and the operator who observes the call places one of her switch-plugs D into the switch of the line at her board. This automatically disconnects the contacts *g h* of the line-switch and connects the two contacts of the plug with the two contacts *g j*, respectively, of the line-switch. These contacts *g j* being connected to the two sides of the line, respectively, and the cord-circuit of the plugs being bridged by the two contacts of the other plug of the pair resting on the strip *o* the line is in a closed circuit which contains the subscriber's telephone and into which the operator has or may switch his own telephone. The operator's and the subscriber's telephones being thus in closed circuit with each other the subscriber, by conversation, transmits his order. The operator then tests the line of the subscriber wanted, and if she finds it to be unswitched or free she places the other plug of the pair into the switch of the line wanted. This automatically disconnects the contacts *g h* of this line and connects the contacts of the plug to the two contacts *g j* of this line, which are connected to the two sides of the line, respectively. The two lines are therefore brought into closed circuit with each other. The operator then calls the subscriber wanted, as has been indicated, and finally leaves the subscribers' lines connected together with the clearing-out annunciator in their circuit. It will be seen that when an operator places a plug into any switch of a line the secondary of the induction-coil of the line is automatically and instantly disconnected from the circuit of the line by the opening of the pair of contact-points *g h* of

the switch, and also that there can be no complete circuit established from any contact *j* of any switch of the line which contains the secondary of the induction-coil, because of the opening of the contacts *g h* at the switch into which the switch-plug has been inserted.

It will be observed that in the operation of the system as shown and described a subscriber on operating his generator sends a current through a closed metallic circuit in which is the line-annunciator; also that when a line is switched at the central office the portion of the circuit in which is the annunciator and the secondary of the induction-coil is cut out. Each operator has one cord system (with as many pairs of cords as she may require) and one test system, and they should be so placed and connected at her board that she can readily perform the operations required of her.

The rheotome shown is an electric rheotome or circuit-breaker, which automatically breaks and makes the circuit in which it and the battery B′ are included. Any form of constantly-operating rheotome may be used.

The two sides or branches of a line being open to each other at the subscriber's station, as shown and described, when the line is not in use there is normally no complete circuit on the line through the secondary of the induction-coil, and consequently, although there is a constant make-and-break current in the primary, there will be no intermittent current normally in the secondary of the coil and over the line-circuit. There being normally no intermittent or variable circuits in the circuits of the lines of the exchange due to the action of the induction-coils in their circuits there can be normally no such inductive disturbances from neighboring circuits, due to the use of the induction-coils, as would exist were the secondaries of the induction-coils normally in closed circuit in their own lines. When, however, an operator makes a test of a line by placing his test-plug T on the contact-piece *j* of a switch of the line and the line is not switched for conversation and the subscriber's telephone is on his switch, a complete circuit is established, in which are the secondary of the coil and the test receiving instrument, and an intermittent induction-current flows over the circuit, operating the test receiving instrument. This complete circuit is from the subscriber's ground through his switch contact-points to the line, over the line and through the several pairs of line contact-points, through the secondary of the induction-coil to contact-piece *j* of the line tested, and thence to ground through the operator's test system. If when the test is made the line is in use, either by its being switched at some board and a pair of its switch-points being opened or by the subscriber's telephone being off its switch, there will be no complete circuit established and the test receiving instrument will not respond. The operator therefore knows that either the line is switched for use or that the subscriber's telephone is switched for use, and she will not connect to the line.

When two subscribers' lines are connected together for conversation, the secondaries of the induction-coils of the two lines are both switched out of their line-circuits, and no current from them will pass through a test receiving instrument on a test being made whether both subscribers' telephones are off or on their hooks or one is off and the other on its hook.

In multiple-switchboard systems an operator to whom certain lines are assigned to answer frequently receives several annunciator calls at practically the same moment, and it may require some time before she can switch to a certain line and answer its call. In systems in which the test depends only on the switching of the line at some other board another operator may, in the meantime, test the line, and finding it to test "free" may switch it with another line and cause annoyance and confusion to the subscriber. In my system this trouble is obviated, because as soon as the subscriber takes his telephone from its switch the line will test "busy," whether or not it is switched at the central office.

Again, in systems of testing which depend only on the subscriber's telephone being on or off its switch confusion frequently occurs from the fact that a subscriber places his telephone on its switch when he is through conversation without sending in a clearing-out signal and his line tests "free" and is "connected to" when it is already switched at the central office with another line. Lines in this condition are technically called "tied up." In my system this trouble again is obviated, because the line will test "busy" until it is disconnected at the central office, whether or not the subscriber's telephone is on its switch. The system therefore combines the advantages and obviates the disadvantages of the two general systems of testing outlined above. When the subscriber, after operating his calling-generator, removes his telephone from its switch, and thus brings his telephone into closed circuit with his line, he will hear in his telephone sounds produced by the alternate currents of the secondary of the induction-coil until the operator places the switch-plug into the line-switch, whereupon the sound will instantly cease on account of the induction-coil having been thereby automatically switched from the line-circuit. The subscriber thus has an automatic indication that the operator is attending to his call and that he may give his order, and he does not need to wait until spoken to by the operator, but may at once proceed to speak to the operator and give his order.

The battery should be so adjusted to the apparatus and circuits that the induction-current sent to a line when it is tested will not operate the line-annunciator or signal-bell; but the current should be such as to operate

the test receiving instrument used (preferably a telephone) through the circuit described.

I have shown one rheotome and battery as used for two lines. A rheotome and battery may be used for each line or for several lines, according to the character and conditions of the exchange and apparatus, and should two or more lines be connected with one rheotome and battery they may be connected to the primary of the induction-coils in a manner similar to that shown or in other ways which will be apparent to those skilled in the art.

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

1. In a multiple-switchboard exchange, a normally open telephone-circuit, a source of intermittent current in said circuit and a test device and switching apparatus for bridging said telephone-circuit for the purpose of testing.

2. In a telephone multiple-switchboard system, a normally open telephone-circuit, a bridge for said circuit containing a test device, normally open at a set of test-contacts closed by the act of testing, closed at a set of switch-contacts, said switch-contacts being opened when the line is switched for use, and a source of intermittent current normally in said telephone-circuit.

3. In a multiple-switchboard exchange, a normally open telephone-circuit, a normally open bridge containing a test receiving instrument adapted to be closed for testing, a source of intermittent current normally in said telephone-circuit for testing, and contacts and switch apparatus for cutting out said source of intermittent current from said telephone-circuit.

4. In a multiple-switchboard exchange, a normally open telephone-circuit, a bridge for said circuit containing a test receiving instrument, normally open at a set of test-contacts, normally closed at a set of line switch-contacts, said bridge being open at said switch-contacts while the line is switched for use by a subscriber, a source of intermittent current normally in said telephone-circuit, and switchboard-contacts and apparatus for cutting said source of current out of said telephone-circuit when it is switched at a board.

5. In a telephone-exchange system, a metallic-circuit line normally, (or when not in use,) with its two branches open to each other at the subscriber's station and one of them grounded at the subscriber's station when the subscriber's telephone is not switched for conversation but not otherwise, a switch at the central office containing a pair of contact points or pieces normally in contact and a third contact-piece insulated from the rest (except by the circuit connections), said branch of the line which is normally grounded at the subscriber's station passing through said pair of contact-points, and thence, by a circuit-wire, to said third contact-piece, and an induction-coil, the secondary of which is in said circuit-wire and the primary of which is in a circuit with a constantly-operating rheotome and a battery, in combination with a switch-plug adapted to be inserted into said switch and when inserted to disconnect said pair of contact-points which are normally in contact, and a test receiving instrument grounded on one side and connected on its other side to a switch testing plug or device adapted, at the will of the operator, to be connected to said third contact-piece of the switch, substantially as set forth.

6. In a telephone-exchange system, a metallic-circuit line normally, (or when it is not in use,) with its two branches open to each other at the subscriber's station, and one of them grounded at the subscriber's station when the subscriber's telephone is not switched for conversation but not otherwise, a switch at the central office containing a pair of contact points or pieces normally in contact and a third contact-piece insulated from the rest (except by the circuit connections), said branch of the line which is normally grounded at the subscriber's station passing through said pair of contact-points and thence, by a circuit-wire, to said third contact-piece, and an induction-coil, the secondary of which is in said circuit-wire and the primary of which has in circuit with it apparatus which produces intermittent electric current, in combination with a switch-plug adapted to be inserted into said switch, and when inserted, to disconnect said pair of contact-points which are normally in contact, and a test receiving instrument grounded on one side and connected on its other side to a switch testing plug or device adapted, at the will of the operator, to be connected to said third contact-piece of the switch, substantially as set forth.

7. In a telephone-exchange system, a metallic-circuit line, the two branches of which are normally open to each other at the subscriber's station, and one of which is normally grounded at the subscriber's station, and an induction-coil, the secondary of which is in the circuit of the line when it is not switched for conversation but not otherwise, and the primary of which is in circuit with a battery and constantly-operating circuit-breaker, in combination with a switch at the subscriber's station with contact-points to remove said ground connection and close said branches to each other when the subscriber's telephone is switched for use, and a test receiving instrument at the central office, grounded on one side and connected on its other side to a switch testing plug or device adapted, at the will of the operator, to be brought into connection with a contact-piece connected with said line, with said secondary of the induction-coil normally between the point of contact and said normal ground connection at the subscriber's station, substantially as set forth.

8. In a telephone-exchange system, a metallic-circuit line, the two branches of which are normally open to each other at the subscriber's station, and one of which is normally grounded at the subscriber's station, and an induction-coil, the secondary of which is in the circuit of the line when it is not switched for conversation but not otherwise, and the primary of which has in circuit with it apparatus which produces intermittent electric current, in combination with a switch at the subscriber's station, with contact-points to remove said ground connection and close said branches to each other when the subscriber's telephone is switched for use, and a test receiving instrument at the central office, grounded on one side and connected on its other side to a switch testing plug or device, adapted, at the will of the operator, to be brought into connection with a contact-piece connected with said line, with said secondary of the induction-coil normally between the point of contact and said normal ground connection at the subscriber's station, substantially as set forth.

9. In a telephone-exchange system, multiple switchboards, metallic-circuit lines connected to the same, the two branches of each of which are normally open to each other at the subscriber's station and one branch is normally grounded at the subscriber's station, and induction-coils, one for each line, the secondary of which is in the circuit of the line when it is not switched at any board and not otherwise and the primary of which has in circuit with it apparatus that produces intermittent electric current, in combination with switches with contact-points, one switch at each subscriber's station, to disconnect the line from said ground-contact and close the two branches of the line to each other when the subscriber's telephone is switched for use, and test receiving instruments, one at each board, each instrument being grounded on one side and connected on its other side to a switch testing plug or device adapted, at the will of the operator, to be brought into connection with a contact-piece connected with any of said lines, with the secondary of its induction-coil normally between the point of contact and its said normal ground connection at the subscriber's station, substantially as set forth.

10. In a multiple-switchboard exchange, a normally open metallic circuit, a third conductor normally connected to one side of said circuit, a test receiving instrument connected on one side to said third conductor, and on its other side to contacts adapted to be brought into connection with the other side of said metallic circuit, a source of intermittent current in said metallic circuit, cut off therefrom by the act of switching said circuit for use at any board.

11. In a multiple-switchboard exchange, a normally open metallic circuit, normally grounded on one side but disconnected from ground while switched for use, a grounded test-circuit adapted to be brought into connection with the other side of said metallic circuit, a source of intermittent current in said metallic circuit, cut off therefrom by the act of switching said metallic circuit for use at any board.

12. In a metallic-switchboard exchange, a metallic telephone-circuit, comprising, in the order named, a ground connection, telephone-switch contacts, between said ground connection and the direct conductor of the circuit, said telephone-switch contacts being normally or while the telephone is not switched for use closed to each other, said direct-conductor switchboard-contacts at the central office normally or while the line is not switched at the central office closed to each other, the secondary of an induction-coil, test-contacts on the various boards, a return-conductor, and normally open telephone-switch contacts at the subscriber's station between said direct and return conductors, in combination with the primary of said induction-coil containing the source of intermittent current, and a grounded test receiving instrument, adapted to be connected to one of said test-contacts.

MILO G. KELLOGG.

Witnesses:
FRANCES D. KELLOGG,
LE ROY D. KELLOGG.