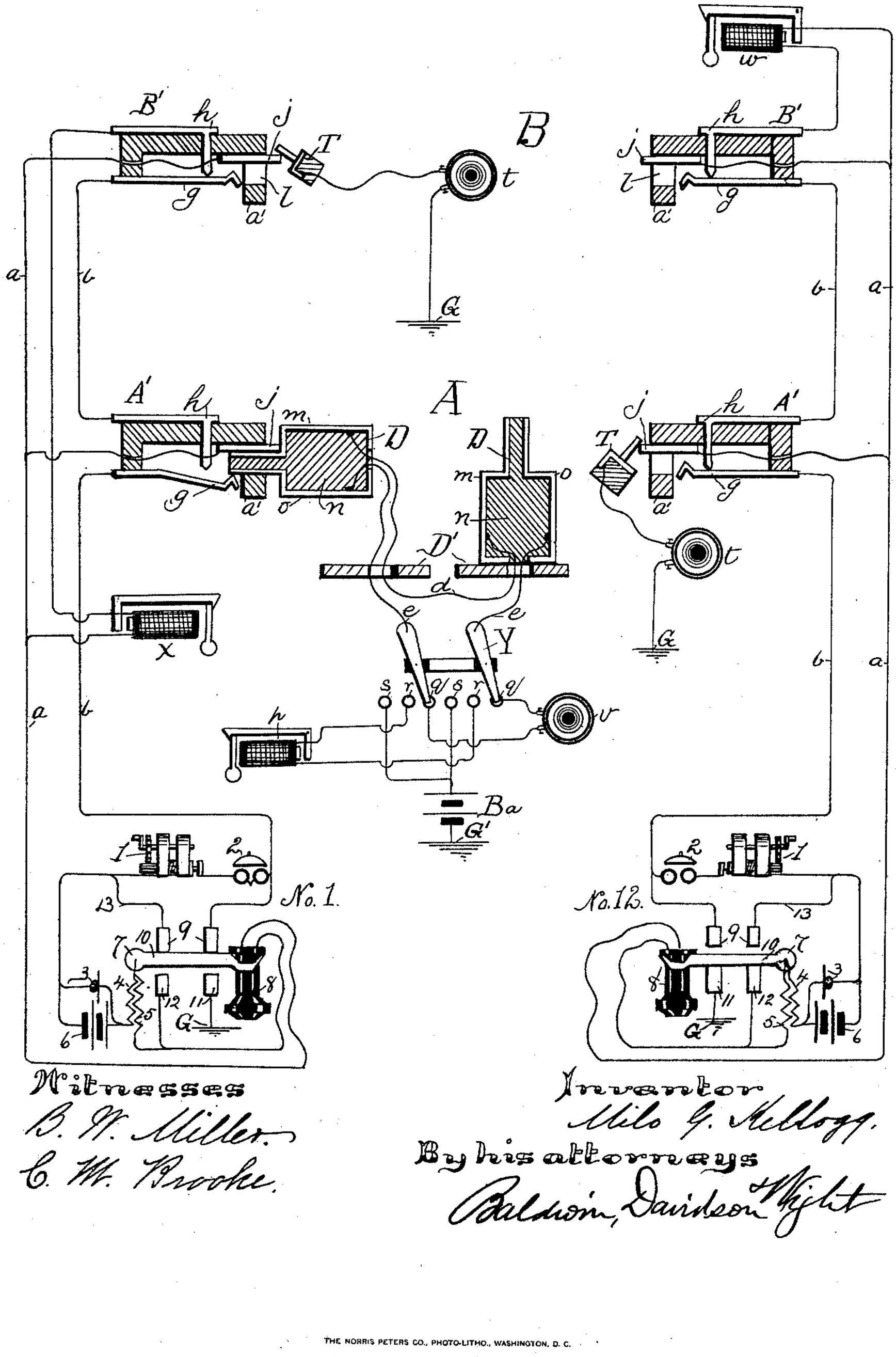
(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,317. Patented Oct. 26, 1897.



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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,317, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,020. (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 drawing, forming a part of this specification.

My invention relates to a telephone-exchange; and it consists in a system of switching and testing the lines thereof to determine whether they are in use.

In the accompanying drawing, illustrating my invention, the figure shows the organization of the circuits and apparatus with which I prefer to use my invention, it being understood that my invention may be used in various organizations referred to hereinafter.

In the figure, A and B represent two boards of a multiple-switchboard exchange, to which are connected the lines of two subscribers—namely, subscriber No. 1 and subscriber No. 12.

A′ and B′ are sections of spring-jacks, to which the telephone-lines are connected. Each spring-jack is composed of an insulating-support a', having a switch-hole l in its front portion. In this hole l is supported a test-contact j, independent of the other contacts of the jack, except by the circuit connections. In each jack is a pair of contacts g and h, normally with the contact g resting upon the contact h, the contact g being connected to that side of the circuit which runs to the subscriber's station. The anvil h is connected to that side of the circuit which runs to the annunciator. The test-contacts j are permanently connected to the limb a of each circuit. The circuit of subscriber No. 12 shows the normal connections, running from ground at G through the switch-contacts 11 and 10, electrically connected to each other by the telephone-switch 7 when in its normal position, thence by way of the primary 4 of the induction-coil, through the battery 6 and transmitter 3 in parallel, thence through the bells 2 and call-generator 1, over the limb b of the metallic to central, thence to the pairs of contacts g and h, through these contacts in the jacks of two or more boards, thence through the line-annunciator w to the test-contacts j in the jacks of the several boards, thence by way of the limb a and receiver 8 at the subscriber's station to the contact 12 of the telephone-switch, normally in contact therewith. The telephone-switch is also connected to the receiver 8 through the secondary 5 of the induction-coil. The contacts 9 short-circuit the call-generator and bells when the telephone-switch is in its upper position—that is, when the telephone is switched for use. This switch is the usual automatic switch. When the telephone is switched for use, the circuit 13 short-circuits the battery from the line connections, at the same time closing its circuit with the primary 4 of the induction-coil. In all circuits like poles of the battery are connected to like sides of the metallic circuit.

At each board is provided one or more sets of operator's cord connections, shown at board A, and a testing-circuit, shown at each board. The operator's cord connection consists of two plugs D, composed of insulating material n, upon which two contacts m and o are mounted, the contacts m connected by the flexible cord connection d. The contacts o are connected together by the flexible cord connection e. In the circuit e is an operator's looping-in switch P, adapted to introduce in circuit therewith the annunciator p for clearing-out purposes, the operator's telephone set v, or the operator's calling-generator B^a, according to whether the levers of the looping-in switch rest upon the contacts q, r, or s. The generator B^a is adapted to ring the bells 2 at the subscriber's station in the usual manner. The plugs D are adapted to be inserted in the spring-jacks A′ and B′, the two contacts m and o of the plugs making electrical connection with the two contacts j and g of the jacks, respectively, thus making connection with the line-circuit in the usual manner. These plugs normally rest upon metallic bases D′, which cross-connect the two contacts m and o of the plugs, thus closing the circuit of the operator's telephone to the calling-line. The test-circuit at each board comprises a telephone t or any other instrument adapted to respond to a current connected on one side to the ground, as at G′,

and on its other side to a test-plug T, adapted to be brought into connection with a test-contact *j* of any jack at its board and thereby establish a circuit for testing.

The operation of this system is as follows: The subscriber operates his call-generator 1, sending a current through the bells 2, battery 6, and transmitter 3 in parallel, primary 4 of the induction-coil, switch-lever 7, contact 12, receiver 8, limb *a* of the metallic circuit, to the annunciator *x*, thence by way of contacts *h* and *g* and limb *b* back to the generator. This current operates the annunciator, giving a signal to the operator at the board at which it is placed. The subscriber removes his telephone from its hook and the operator at central makes connection to the line, as shown, at the board A with the line of subscriber No. 1, supposing that subscriber No. 1 has called, her plug lifting the contact *g* from its anvil *h*. The operator then places her looping-in switch upon the contacts *g*, thereby introducing her telephone set into the following circuit: from the subscriber's station by way of limb *b*, contact *g*, contact *o*, flexible-cord circuit *e*, through the operator's telephone, thence to the contact *o* of the other plug D, metallic base D′, contact *m*, flexible-cord circuit *d* to the contact *m* of the first-mentioned plug, contact *j* to limb *a* of the metallic circuit, thence through receiver 8, the secondary 5 of the induction-coil to the telephone-switch 7, thence by contact 9 to limb *b* again. The subscriber's transmitter-circuit consists of three parallel branches, one containing battery 6, another containing the transmitter 3, a third containing the primary 4 of the induction-coil on closed circuit through the telephone-switch 7, contact 9, and branch 13. Varying the amount of current flowing through the transmitter branch varies the current flowing through the primary of the induction-coil. These variations are transmitted to line by the secondary coil 5.

Speaking into the transmitter 3, subscriber No. 1 orders connection with, say, No. 12. The operator at board A then applies her test-plug *t* to the test-contact *j* of the jack of line No. 12 to ascertain its condition. Subscriber's telephone being on its hook, as shown, a test-circuit is established as follows: from ground at G′, test receiving instrument *t*, test-plug T, test-contact *j*, limb *a* of the metallic circuit, annunciator *w*, limb *b* of the metallic circuit, through contacts *g* and *h*, which are closed to each other normally or when the line is not switched for use, thence to the subscriber's station, bells 2, generator 1, subscriber's battery 6, primary 4 of the induction-coil, switch-lever 7, contacts 10 and 11 to ground at G. The presence of the battery 6 in this circuit causes a click in the telephone *t*, thereby announcing to the operator that the subscriber's telephone is on its switch and that the line is not switched at central. Transmitter 3 is in parallel with this test-circuit, but its resistance prevents all the current from being shunted therefrom. The battery should not be so strong as to operate the annunciator *w*. Upon finding that the line is free the operator inserts the other connecting-plug D into the switch tested, loops first her call-generator B[a] and then clearing-out annunciator *p* into the cord-circuit by means of the looping-in switch and then leaves the line connected for conversation. Subscriber No. 12 removes his telephone from its switch for use. If now an operator at board B tests either of these lines while thus connected, her test-circuit will be open at both contacts *g* and *h* and 10 and 11, so that her test receiving instrument has no current to respond to. If the subscriber 12 should hang up his telephone and the lines remain otherwise in their connected condition, a test-circuit would exist as follows: from the test-contact *j* of line 12, for example, to which the test-plug is applied, to the limb *a* of the metallic circuit, thence through the receiver 8 and contacts 12, 10, and 11 to ground at G. There is no battery in this circuit to actuate the test receiving instrument. Another test-circuit would exist as follows: test-contact *j* at board B, as before, by limb *a* to the contact *j* at board A, contact *m* of the plug D, circuit *d*, to the contact *m* of the other plug D, contact *j* of subscriber No. 1, thence by way of limb *a*, receiver 8, contact 10 of the switch 7, contact 9, limb *b*, to central, contacts *g* and *o*, circuit *e*, containing the clearing-out annunciator *p*, contacts *o* and *g*, in connection when plug D is connected with line No. 1, limb *b* of the metallic circuit to the subscriber's station, bells 2, generator 1, battery 6, primary coil 4, telephone-switch 7, contacts 10 and 11, to ground at G. If the battery 6 is too strong, it will operate the test receiving instrument of the operator at board B, causing a free test when the lines are busy. To obviate this, the battery 6 may be so adjusted as to strength to the test receiving instrument used that with the added resistance of another circuit the test receiving instrument will not respond in the usual manner.

If both lines are connected at central and both telephones are upon their switches at the subscribers' stations, the test receiving instrument will be short-circuited with reference to the test-batteries, so that the instrument will be practically out of the circuit of either battery when the test is applied. Any closed circuit which contains the test receiving instrument when the lines are connected together and the telephones are on the switches and the test is applied may be traced thus: from the ground at the central office through the test receiving instrument and test-plug to contact *j*, to which the plug is applied, thence in either direction to one of the subscribers' stations through his line conductor *a* to the lever 7 of his telephone-switch, thence through the short-circuit connection at that station formed by the connection of

the switch-lever with contact 11 of the switch and the wire to ground. This circuit includes the resistance of the test receiving instrument, the line conductor, and the subscriber's receiver. The circuit containing the test-batteries may be traced from ground through the contact 11, the switch-lever 7, thence through the subscriber's battery 6, signal-receiving bell 2, and limb *b* to the central office, thence through the cord conductor *e* to limb *b* of the other subscriber's line to his station, and through his signal-receiving bell and battery to the lever 7 of his switch, and thence to ground through the lever and contact 11 of the switch which is connected to the ground. It will be seen that the circuit containing the test-batteries has two branches from each switch when the lines are tested, one branch being over the line conductor *a* to a contact *j* and a grounded test outfit connected thereto, the other branch being through the short circuit around this branch from contact 11 to ground. This circuit to ground being of practically no resistance and the other circuit to ground, that through the test outfit being a long circuit of much resistance, the circuit which contains the test receiving instrument is short-circuited by this subscriber's ground connection of practically no resistance. Again, tracing the circuit back from one subscriber's ground through the batteries and the two connected limbs *b b* of the two lines and thence back at the central office to ground through the limb *a* of the second subscriber's line and the test receiving instrument, the ground connection to the circuit at the second subscriber's station being of practically no resistance, and the circuit back to ground through the limb *a* and the test receiving instrument being of considerable resistance, the test receiving instrument is then short-circuited with reference to the battery-circuit.

It is of course understood that my invention may be used in various organizations, in grounded-circuit systems, in law systems, and in various other organizations well known to the art; nor do I limit my invention to systems in which switches and plug and cord connections are used, for it is obvious that various other kinds of mechanism and apparatus may be used to accomplish the same functions.

It is also evident that instead of magnetic telephones bells may be used as test receiving instruments. Certain switching apparatus is unnecessary in such a system suitably modified.

The annunciators of the various lines are distributed among the various boards to equalize the work of the various operators.

In multiple-switchboard systems in which the test receiving instrument and the test-battery are in a ground connection of the test outfit at the central office and in which the test depends upon the ground connection of the line either at the subscriber's station or at central open while either the line or the subscriber's telephone is switched for conversation any accidental ground on the circuit of two lines connected together for conversation will whenever either "busy" line is tested produce a false signal that the line is "free" or not in use. The operator who made the test and obtained the false signal will switch the line with another line, thus connecting the three lines together and producing confusion. This renders the test system for the time being practically inoperative as far as these lines are concerned. Moreover, a break or escape from the circuit to ground, even although of high resistance, will when the magneto-telephone is used as test receiving instrument produce the same result. Moreover, with line-circuits of considerable static capacity, particularly when cables are used, and with magneto-telephones as test receiving instruments the flow of current from the battery to the line when the test is made will produce the false signal even though there is no ground or ground escape from the circuit of the two connected lines. With the organization herein described with the test-battery, one for each line, located in the circuit of the line and cut out from the line-circuit while the subscriber's telephone is switched for use no false signal from the battery can be produced in the test receiving instrument when the test is made, and confusion incident to the other system described above is thereby avoided. This result and advantage is obtained by the position of the batteries in the circuits for testing, as herein described.

In multiple-switchboard systems an operator to whom certain lines are assigned to answer frequently receives several calls at practically the same moment, and it may take some time before she can switch to a certain line and answer its call. In systems in which the test only depends upon 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, causing annoyance and confusion to the subscriber. In my system this trouble is obviated, for 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 off or on its switch confusion frequently occurs when a subscriber places his telephone on his switch after finishing conversation without sending any clearing-out signal, and his line will test free and be connected to when it is already switched at the central office. Lines in this condition are technically called "tied up." In my system again this trouble 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 both the general systems outlined above.

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

1. In a multiple-switchboard exchange, a telephone-circuit, a test-circuit associated therewith including normally closed switchboard-contacts at central opened while in use, and including a pair of normally closed switch-contacts at the subscriber's station opened when the subscriber's telephone is switched for use, and including also a test-battery individual to the subscriber and located in said circuit between said normally closed contacts at central and at the subscriber's station.

2. In a multiple-switchboard exchange, a telephone-line, a test-circuit associated therewith including normally closed switchboard-contacts, opened when said telephone-line is switched for use at central, and including normally closed switch-contacts at the subscriber's station open while the telephone is switched for use, and including also a test-battery individual to the subscriber and located in said test-circuit between said contacts at central and at the subscriber's station switched from said test-circuit while the telephone is switched for use.

3. In a multiple-switchboard exchange, a telephone-line, and a test-circuit, a conductor common to both containing a test-battery individual to the subscriber, a pair of normally closed switch-contacts on one side of said battery, opened while the subscriber's telephone is switched for use, and normally closed switchboard-contacts at central on the other side of the battery, open while the telephone-line is switched for use thereat.

4. In a multiple-switchboard exchange, a telephone-line containing in the order named a normal ground connection at the subscriber's station, telephone-switch contacts by which said connection is opened when the telephone is switched for use, a combined test and transmitter battery, normally closed switchboard-contacts at two or more boards opened while the line is switched for use thereat, and test-contacts at said boards, in combination with grounded test receiving instruments at said boards adapted to be connected to said test-contacts for testing.

5. In a multiple-switchboard exchange, a metallic-circuit line and test-circuit associated therewith containing, in the order named, a normally closed ground connection at the subscriber's station, a combined test and transmitter battery, a line conductor, switchboard-contacts at central normally closed but open while the line is switched for use, test-contacts at said boards, and a return-conductor connected at the subscriber's station to the normally-grounded limb, in combination with grounded test receiving instruments adapted to be connected to said test-contacts for testing.

6. In a multiple-switchboard exchange, a telephone-line, a test-circuit associated therewith including normally closed switchboard-contacts at central, opened while in use, and including a pair of normally closed switch-contacts at the subscriber's station opened when the subscriber's telephone is switched for use, and including also a test-battery individual to the subscriber and located in said test-circuit between said normally closed contacts at central and at the subscriber's station, switched from said circuit while the line is in use.

7. In a multiple-switchboard exchange, a telephone-line, a test-circuit, a conductor common to both, containing an individual test-battery when the subscriber's telephone is not switched for use but not otherwise in said circuit, a pair of normally closed switch-contacts on one side of said battery opened while the subscriber's telephone is switched for use, and normally closed switchboard-contacts at central on the other side of said battery open while the line is there switched for use.

8. In a multiple-switchboard exchange, two tied-up lines connected together at a board, subscribers' outfits in their normal position, test-batteries in said lines, grounded test receiving instruments applied to said connected lines for testing, and ground connections short-circuiting said test receiving instruments rendering them unresponsive to said battery or batteries.

9. In a multiple-switchboard exchange, two tied-up lines connected together at a board, a test-battery in each of said lines, a test receiving instrument in circuit with said batteries, and a short circuit rendering said instrument unresponsive to said batteries.

In witness whereof I hereunto subscribe my name this 4th day of October, 1889.

MILO G. KELLOGG.

Witnesses:
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FRANCES D. KELLOGG.