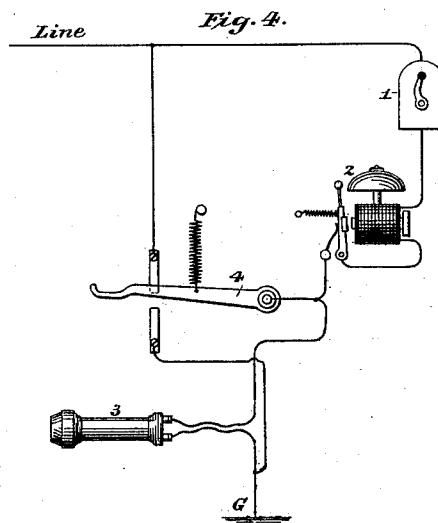
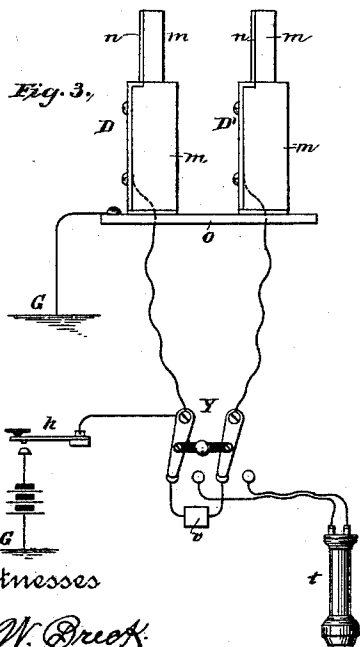
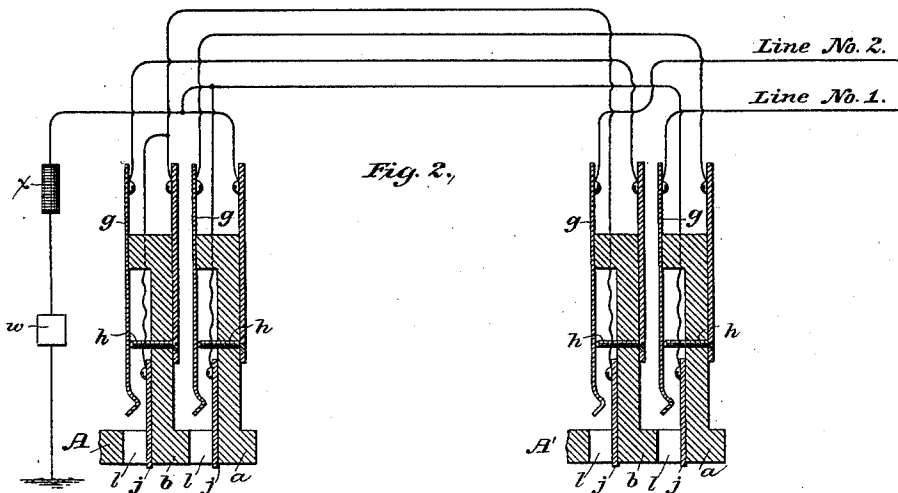
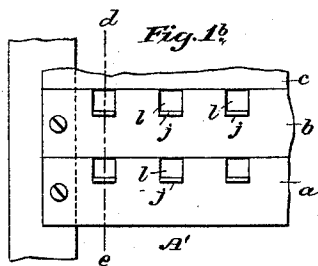
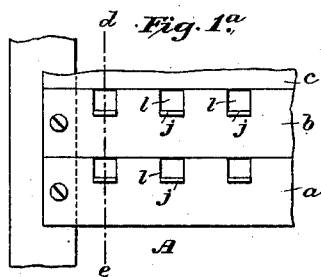


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,318.

Patented Oct. 26, 1897.



Witnesses
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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. 592,318, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,021. (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 single-circuit telephone-lines; and it consists in a system of switching and testing such lines to determine whether they are in use.

In the accompanying drawings, illustrating my invention, Figures 1^a and 1^b are front views of sections of two multiple switchboards to which the same lines are connected. Fig. 2 is a diagram illustrating the main-line switchboards, apparatus, and connections necessary to illustrate my invention. Fig. 3 is a diagram of an operator's cord system to be used in connection with said system. Fig. 4 is a diagram of a subscriber's-station apparatus necessary to illustrate my invention.

In the figures like parts and apparatus are represented by the same letters and numerals of reference.

G is a ground connection.

In Fig. 2, A is a sectional view of the switchboard shown in Fig. 1^a, and A' is a sectional view of the board shown in Fig. 1^b, each as indicated by the line *d e*.

There are as many boards in the exchange as are necessary to answer the calls and make the 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 switch-plug, and when the plug is inserted to disconnect the spring from the contact-point and form connection between the spring and the contact-point of the plug.

In Fig. 2, *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. *ll* are the switch-holes. *ab* are the rubber strips on which the switch parts are mounted, as

shown, and through the fronts of which are the switch-holes *ll*. These holes are adapted to receive the switch-plugs shown in Fig. 3 and marked D D', and when a plug is inserted into a switch it operates it as above described. The contact-pieces *j j* should be so placed that a test-plug or contact-point may be readily applied to them. Their function in this system is to form test-pieces or test contact-points for their lines, and they may be placed as shown, or in any convenient position on their respective boards.

The connection of each line to the switchboards is as follows and as shown. A line normally grounded at the central office passes successively through the pairs of contact-points of its switches on the boards, passing in each case to the spring first. It then passes through its line-annunciator to ground. A suitable resistance-coil may also be placed in this ground connection, if desired, or a resistance-coil may be substituted for the resistance of the annunciator.

w is an annunciator, and *x* is a resistance-coil. The contact-pieces *j j* of the line are connected to the line, the connection being between the switches and the resistance in the ground connection, whether annunciator or coil. In lines that are normally open to the ground at the central office the ground connection may be left off and the line, after passing through the pairs of contact-points, as above indicated, is connected to contact-pieces *j j* of its switches. Independent calling-circuits are generally used for such lines, as in the Law system. "Line No. 1," as marked, shows the connection of a line normally grounded and "Line No. 2" of one normally open at the central office.

Fig. 3 shows an operator's cord system with one pair of cords and their plugs, switch-annunciator, key, and operator's telephone and battery.

The plugs D D' are constructed substantially as shown, *m m* being the rubber insulations and *n n* their contact-pieces, and they should be inserted into the switches in such a position that the contact-piece of the plug is in connection with the switch-spring and is not in connection with the switch contact-piece *j*.

o is a metal strip on which the bases of the plugs normally rest and which connects then the contact-pieces of the plugs with the ground.

5 *y* is the looping-in switch of the pair of cords.

v is the clearing-out annunciator, and *k* is the test-key.

10 *t* is the operator's telephone, and *B* her calling and testing battery. The circuits are as shown.

The method of connecting other pairs of cords with their accompanying switches, keys, and apparatus to the telephone and battery 15 will be apparent to those skilled in the art.

The method of operating the system in connection with the switchboards will be apparent to those skilled in the art. On account of the testing system, which will hereinafter 20 be explained, the operator in testing a line should use the plug marked *D'*, and consequently should preferably use the plug *D* in answering a call. Each operator has one cord system, with as many pairs of cords as she 25 may need, and the parts are conveniently mounted and arranged at her board to operate the system.

In the subscriber's - station apparatus shown in Fig. 4, 1 is the calling-generator; 30 2, the signal-bell; 3, the subscriber's telephone, and 4 the telephone-switch. The contact points and circuits are as shown, or otherwise arranged, so as to substantially perform the operations hereinafter described. 35 The signal-bell shown has an automatic electric-circuit breaker which makes and breaks the circuit when it is directly in the circuit of the line and a suitable current is sent over the line. Other devices for varying the current 40 may be employed, some of which are hereinafter mentioned. When the subscriber's telephone is on its switch, the circuit-breaker is in the direct circuit of the line and will respond to the current which may be 45 sent over it. When the telephone is off from the switch, the circuit-breaker is shunted by a wire or small resistance, so that it will not respond to any current sent over the line. The condition of the line is thereby changed 50 when the telephone is off from its switch from what it is when the telephone is on the switch, and this change of condition operates to determine the test, as will be apparent.

The system of testing is as follows: An operator on testing places the contact-piece or 55 contact-point *D'* of a pair of plugs on the contact piece or point *j* of the line to be tested and presses on the test-key *k*. The circuit connections through the switch *Y* are such 60 that in order to include the test-telephone *t* the plug *D'* must be used, and when a test is made the other plug *D* of the pair should be removed from the ground-plate *o*, and said plug will be generally in the switch of the 65 line that has just called. Otherwise the test-battery would be short-circuited to earth through the ground-plate *o*. If the line is

not switched at any board, a complete circuit is established through her telephone and battery and the line, and if the subscriber's 70 telephone is on his switch the automatic circuit-breaker will be in the circuit and will operate to make and break the circuit and the operator will hear the make and break and will know that the line is "free." If, 75 however, when she makes the test the line is switched at some other board, this circuit is open at the pair of contacts of the switch used and the instrument will not respond. If, again, the line is not switched at the central office, but the subscriber's telephone is 80 off its switch for use, the operator's telephone will not respond to a make and break. When an operator tests and gets no test response, she knows that either the line is switched for 85 use at the central office or that the subscriber's telephone is switched for use and that the line is thereby "busy," and she will not connect it with another line. It will be observed that when a test is made, as indicated, 90 of a line grounded at the central office part of the current will seek the ground through the resistance-coil and the annunciator and resistance of that part of the line which is in the circuit between the test-piece used 95 and the ground. The proportion of current passing through this channel and that which passes over the line will depend on the comparative resistances of the two circuits. A considerable resistance may, if desired, be 100 placed in this ground-circuit at the office and thereby cause a large proportion of the current to go to line. The battery should be such as to operate the automatic circuit-breaker when it is connected in the test-circuit, as indicated. When a test is made and 105 a line is switched, the operator will hear a click on making the test and on interrupting the connection. This, however, will be quite different from the continual make and break 110 of a circuit-breaker and will not confuse her.

The automatic circuit-breaker or bell 2 at the subscriber's station is illustrative or representative of a class of apparatus which gives a defined indication on the test receiving instrument, or, in other words, an apparatus which produces a variable condition of the circuit or the electrical condition on the line; but my invention is in no sense limited to the particular type of such apparatus 120 shown.

In the claims I have used the term "current-varying device," intending to include thereby various kinds of devices or apparatus for varying the current or electrical condition 125 on the line. Obviously any electrician may vary such apparatus, and as instances of obvious variations I refer to the following constructions which might be adopted:

First. A bell may be employed in which the 130 contact-points alternately shunt the bell-magnet when on closed circuit with the battery, thus alternately increasing and decreasing the resistance of the circuit.

Second. I may employ a constantly-operating rheotome actuated by a clock-movement or otherwise, with which there might be used a signal-bell that would respond to the makes and breaks of the rheotome.

Third. A resistance-coil and a constantly-operating rheotome arranged in multiple circuit might be used, the rheotome alternately short-circuiting the coil and thereby increasing and decreasing the resistance of the circuit. With this arrangement a calling-bell could be employed that would respond to the increase and decrease of resistance.

Obviously any of these apparatus may be used in operating my invention, because the invention relates to a general organization or system and not to the details of the particular apparatus that may be employed at the subscriber's station.

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 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 to 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 some other line. 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 the two general systems of testing outlined above.

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

1. A test-circuit for a subscriber's line, containing an automatic circuit-breaker in the circuit at the subscriber's station when his telephone is not switched for use but not otherwise, and at the central office a pair of contact-points open when the line is switched at its board but not otherwise, a pair of contact-points normally open but closed by the operator on testing, and a test receiving instrument and battery, substantially as set forth.

2. A test-circuit for a subscriber's line, containing at the central office a pair of contact-points open when the line is switched at its

board but not otherwise, a pair of contact-points normally open but closed by the operator on testing, a test receiving instrument and battery, and a current-varying device at the subscriber's station normally in said test-circuit but switched from it when the subscriber's telephone is switched for use, substantially as set forth.

3. A test-circuit for a subscriber's line, containing an automatic circuit-breaker at the subscriber's station when his telephone is not switched for use but not otherwise, and at the central office a series of pairs of contact-points normally closed, one pair on each of several multiple switchboards and each pair open when the line is switched at its board, a pair of contact-points normally open but closed by the operator on testing, and a test receiving instrument and battery, substantially as set forth.

4. A test-circuit for a subscriber's line, containing at the central office a series of pairs of contact-points normally closed, one pair on each of several multiple switchboards and each pair open when the line is switched at its board, a pair of contact-points normally open but closed by the operator on testing, a test receiving instrument and battery, and a current-varying device at the subscriber's station normally in said test-circuit but switched from it when the subscriber's telephone is switched for use, substantially as set forth.

5. A test-circuit for a subscriber's line, containing at the subscriber's station an automatic circuit-breaker in circuit when his telephone is not switched for use but not otherwise, and a pair of contact-points normally closed but open when the line is switched for use, a series of branch or derived circuits to said test-circuit, each containing a test receiving instrument and a pair of contact-points normally open but closed by the operator on testing, and a test-battery, substantially as set forth.

6. A test-circuit for a subscriber's line, containing at the central office a pair of contact-points normally closed but open when the line is switched for use at its board, a branch or derived circuit to said test-circuit, containing a test receiving instrument and a pair of contact-points normally open but closed by the operator on testing, and a test-battery, an instrument at the subscriber's station which gives a defined indication on said test receiving instrument when closed with it and the battery and which is normally in said test-circuit but switched from it when the subscriber's telephone is switched for use, substantially as set forth.

7. A test-circuit for a subscriber's line, containing at the subscriber's station an automatic circuit-breaker in circuit when his telephone is not switched for use but not otherwise, and at the central office a series of pairs of contact-points normally closed, one pair on each of several multiple switchboards, and

each pair open when the line is switched at its board, a series of branch or derived circuits to said test-circuit, one for each of said boards and each containing a test receiving instrument, a battery, and a pair of contact-points normally open but closed by an operator on testing, substantially as set forth.

8. A test-circuit for a subscriber's line containing at the central office, a series of pairs of contact-points normally closed, one pair on each of several boards, and each pair open when the line is switched at its board, and a series of branch or derived circuits to said test-circuit, one for each of said boards, and each containing a test receiving instrument and a pair of contact-points normally open but closed by an operator on testing, a test-battery and a current-varying device at the subscriber's station normally in said test-circuit but switched from it when the subscriber's telephone is switched for use, substantially as set forth.

9. In a telephone-exchange system, a subscriber's line grounded at its outer end and containing at the subscriber's station an automatic circuit-breaker when the subscriber's telephone is not switched for use but not otherwise, a switch at the central office having a pair of contact-points normally in contact, but separated by the insertion of a switch-plug, and a test contact-piece insulated from the rest, (except by the circuit connections,) said line passing through said pair of contact-points and thence to said test contact-piece, in combination with a test receiving instrument grounded on one side and connected on its other side to a test plug or device, adapted, at the will of the operator to be brought into connection with said test contact-piece and a battery in the test-circuit, substantially as set forth.

10. In a telephone-exchange system, a subscriber's line normally grounded at the outer end and containing at the subscriber's station an automatic circuit-breaker when the subscriber's telephone is not switched for use, but not otherwise, and at the central office a switch containing a pair of contact-points normally in contact but separated by a switch-plug on its insertion, a test contact-piece insulated from the rest (except by the circuit connections) and a resistance, said line passing through said pair of contact-points and thence through said resistance to ground, and said test contact-piece being connected to the line-circuit between the pair of contact-points and the resistance, in combination with a test-wire containing a test receiving instrument and battery grounded at one end and connected at its other end to a test plug or device adapted, at the will of the operator, to be brought into connection with said test contact-piece, substantially as set forth.

11. In a telephone-exchange system, a subscriber's line grounded at its outer end, and at the central office, a switch containing a pair of contact-points, and an insulated test con-

tact-piece, said line passing through said contact-points and thence being connected to said test contact-piece and said contact-points being normally in contact but opened by a switch-plug on its insertion, in combination with a test receiving instrument grounded at one side and connected at its other side to a switch plug or device adapted, at the will of the operator, to be brought into connection with said test contact-piece, a battery in the test-circuit, and a current-varying device at the subscriber's station normally in circuit with said line but switched from circuit when the subscriber's telephone is switched for use, substantially as set forth.

12. In a telephone-exchange system, a subscriber's line grounded at its outer end and at the central office a switch containing a pair of contact-points normally in contact but separated by a switch-plug on its insertion, a test contact-piece insulated from the rest (except by the circuit connections) and a resistance, said line passing through said pair of contact-points and thence through said resistance to ground and said test contact-piece being connected to its circuit between the pair of contact-points and the resistance, in combination with a test receiving instrument grounded on one side and connected on its other side to a test plug or device adapted, at the will of the operator, to be brought into connection with said test contact-piece, a battery in the circuit between the plug and the ground, and a current-varying device at the subscriber's station normally in the circuit of the line but switched from the circuit when the subscriber's telephone is switched for use, substantially as set forth.

13. In a telephone-exchange system, multiple switchboards, single-circuit lines connected to the same, each line being grounded at its outer end and having at its subscriber's station an automatic circuit-breaker, and a switch with contact-points to switch the circuit-breaker into the circuit of the line when the subscriber's telephone is not switched for use and to switch it from the circuit of the line when the telephone is switched for use, in combination with test contact-pieces one for each line on each board and normally connected to the line, switches with contact-points to disconnect any line from its test contact-pieces when it is switched for use, test receiving instruments, one at each board, each grounded on one side and connected on its other side to a test plug or device adapted, at the will of an operator, to be brought into connection with any test contact-piece at its board, and a test-battery, substantially as set forth.

14. In a telephone-exchange system, multiple switchboards, telephone-lines connected to the same and each grounded at its outer end and having at its subscriber's station an automatic circuit-breaker and a switch with contact-points to switch the circuit-breaker into the circuit of the line when the subscriber's

telephone is not switched for use and to switch
it from the circuit of the line when the tele-
phone is switched for use, in combination
with test contact-pieces, one for each line, on
5 each board, and normally connected to the
line, switches with contact-points to discon-
nect any line from its test contact-pieces when
it is switched for use, resistance-coils, each
grounded on one side and connected to the
10 circuit of a line between the contact-points
of its switches and its test contact-pieces, and
test wires or circuits, one for each board, each
containing a test receiving instrument and

battery and grounded at one end and con-
nected on its other end to a test plug or de- 15
vice adapted, at the will of an operator, to
be brought into connection with any test con-
tact-piece at her board, substantially as set
forth.

In witness whereof I hereunto subscribe my 20
name this 18th day of October, 1889.

MILO G. KELLOGG.

Witnesses:

FRANCES D. KELLOGG,
MARGARETHA RIEHL.