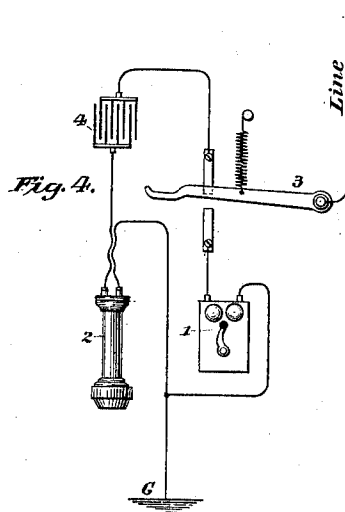
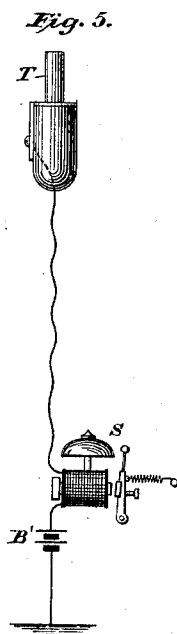
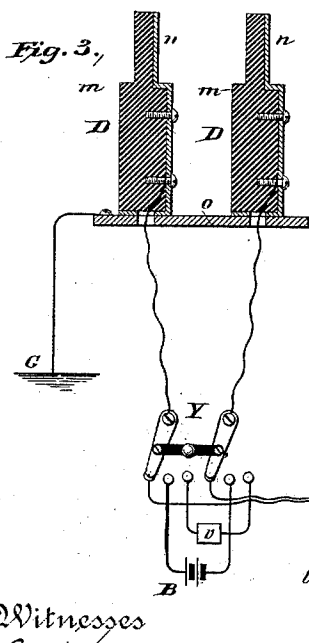
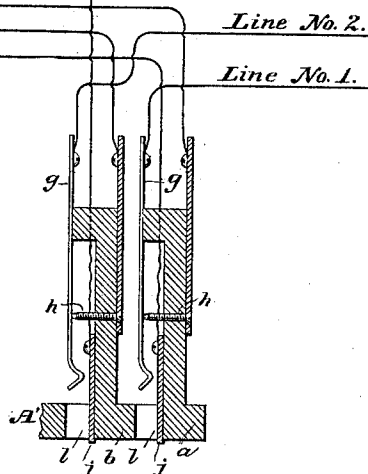
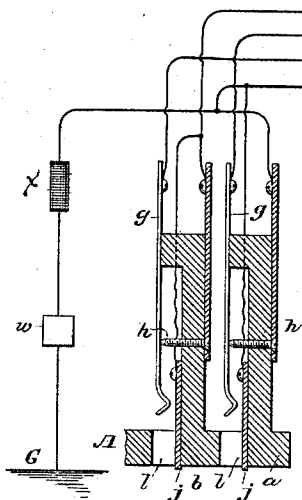
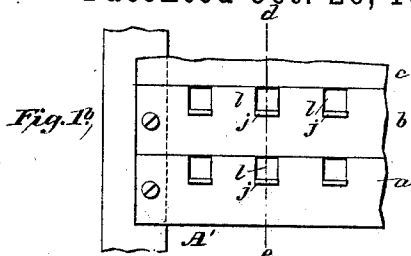
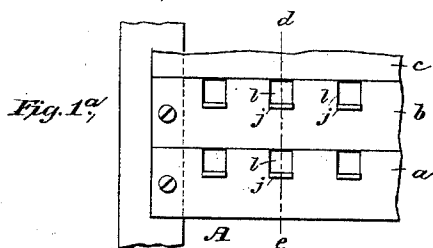


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,321.

Patented Oct. 26, 1897.



Witnesses
Geo. W. Brock
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. 592,321, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,024. (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 single-circuit telephone system; and it consists in a system of 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 shows a diagram of an operator's cord system to be used in connection with said boards. Fig. 4 is a diagram of a subscriber's-station apparatus necessary to illustrate my invention. Fig. 5 shows an operator's test system to be used at the boards.

G in each case of the drawings represents a ground connection.

Like parts and apparatus are designated by the same letters and figures of reference.

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

There are as many boards in the exchange as are necessary for the number of lines. 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 a plug is inserted to disconnect the spring from the contact-point and form connection between the spring and the contact-piece 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.

l l are the switch-holes.

a b are the rubber strips on which the metal parts are mounted, as shown, and through the fronts of which are the holes *l l*. 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 may be readily applied to them. Their only function is to form test-pieces for their lines, and they may be placed as shown or in any convenient position on their boards.

The connections of a 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 several boards, passing in each case to the spring first. It then passes through an annunciator and resistance-coil to ground.

w is the annunciator, and *x* is the resistance-coil. The contact-pieces *j j* of the line are connected to the line, the connection being between the switch-points and the resistance of the annunciator and resistance-coil. In lines which are normally open to the ground at the central office the line, after passing through the pairs of contact-points of its switches, is connected to its contact-pieces *j j*. Independent calling-circuits are generally used for such lines, such as the Law and American district systems. Line No. 1, as indicated, shows the connection of a line normally grounded and line No. 2 the connection of a line normally open at the central office.

Fig. 3 shows an operator's cord system with one pair of cords and their plugs, switch, annunciator, and the operator's telephone and calling generator or battery. The plugs D D are constructed substantially as shown, *m m* being the rubber insulations and *n n* the contact-pieces, and they should be inserted into the switches in such a position that the contact-piece of the plug forms connection with the contact-spring of the switch and is not in connection with the contact-piece *j*.

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

Y is the looping-in switch, and *v* is the clearing-out annunciator of the pair of cords.

t is the operator's telephone, and B is her calling generator or battery.

5 The looping-in switch Y has two levers and three pairs of contact-bolts, on each pair of which the levers may be alternately placed. The levers are connected together by an insulated cross-piece with a knob by which the
10 operator may at will move the levers by one motion from the pair of contact-bolts on which they normally rest to the next adjoining pair of bolts, and thence to the remaining pair of bolts. The pair of contact-bolts on which
15 the levers normally rest are connected together through the operator's telephone. The next adjoining pair are connected together through the generator, and the remaining pair are connected together through the clearing-out annunciator. The contact-pieces of the two switch-plugs are connected by means of flexible switch-conductors to the two switch-levers, respectively. Where two lines are connected together for conversation by the
25 the insertion of the pair of plugs into their line-switches and the looping-in-switch levers are in the position shown in Fig. 3, the circuit of the two lines contains the operator's telephone. When the operator moves
30 the switch-levers from such position in which they rest on the pair of contact-bolts, which are connected through the annunciator, the telephone is disconnected from the circuit and the generator is first thrown into and then
35 out of circuit, and finally the two lines are connected together through the annunciator. By one motion, therefore, the operator first rings the bell of the subscriber wanted and then leaves the lines connected together for
40 conversation with a clearing-out annunciator in the circuit.

The method of connecting other pairs of cords with their accompanying apparatus to the system as well as the method of operating
45 the system in connection with the switch-boards will be apparent to those skilled in the art. Each operator has one cord system with as many pairs of cords as she may need, and the parts are conveniently mounted and arranged for her work.

In the subscriber's-station apparatus shown in Fig. 4, 1 is the magneto-bell containing a calling-generator, 2 is the telephone, 3 is the telephone-switch, and 4 is a condenser of
55 suitable capacity. The contact-points and circuits are as shown or otherwise arranged so as to substantially perform the operations hereinafter described. The condenser is in the circuit with the line and telephone when
60 the telephone is taken from the switch for use, and it is switched from the circuit of the line when the telephone is placed on the switch.

In the operator's test system shown in Fig. 5, T is the test-plug, S is the test receiving
65 instrument, B' is the test-battery, and G is the ground connection. The several parts are connected as shown. The test receiving

instrument and the battery should be so adjusted to each other and to the circuits that the instrument will respond or sound when
70 the plug is placed on a test contact-piece *j* of a line and the subscriber's telephone is on its switch and the circuit to the line is not opened by the line being switched at one of the
75 boards, but will not sound when the line is switched or when the telephone at the subscriber's station is off from its switch, so that the condenser is in the circuit. The resistance of the office ground connection of the line through the annunciator and resistance-
80 coil should be made large enough so as not to permit enough current to pass through the test instrument to operate the instrument or the annunciator when the test is made. The amount of this resistance will depend on
85 the form and construction of the other parts. The annunciator-magnet might in cases be constructed with sufficient resistance so that no other coil would be required. The system of testing is as follows: An operator, on test-
90 ing, places the contact-piece T of her test system on the test contact-piece *j* of the line tested at her board. If the line is not switched at any board, a complete circuit is established from the ground through the test receiving
95 instrument and battery to the line, and if the subscriber's telephone is on the switch to the ground through his signal-bell circuit the instrument will sound, indicating that the line is "free." If, however, the line is
100 switched at any board or if the telephone is off from its switch and the condenser is in the circuit, the circuit will be open, so that the test receiving instrument will not sound. The operator will therefore know when the
105 instrument does sound that either the line is switched or the subscriber has removed his telephone from the switch for use and she will not switch the line with another one. Each operator has a test-plug and test receiving instrument connected substantially as
110 shown.

The condenser properly constructed and connected in the circuit as shown will not materially affect the continuity of the circuit
115 for the telephone-current.

The use of the resistance-coils in the ground-circuit of the lines, even were they made of several hundred ohms resistance each, would not materially affect the working of the sys-
120 tem, as magneto-generators now in use are constructed to operate the signal-bells and annunciators through circuits of several thousand ohms resistance.

The test system depends on the fact that
125 an electromagnet, with an armature and a retractile spring acting on the armature, may readily be made to move or attract the armature when in closed circuit with a battery and a certain resistance and not to attract
130 the armature when in closed circuit with the battery and a considerably-greater resistance, whereby the amount of current passing through the electromagnet is considerably de-

creased. This construction and adjustment would depend on the style of the electromagnet, the strength of the retractile spring, and the resistances of the circuit and could easily be obtained. When the test is made as above, described and neither the line is switched for use nor the subscriber's telephone is switched for use, the test-circuit is from the office ground through the test-battery and test receiving instrument to the contact to which the plug is supplied, and thence to ground in two derived circuits, one through the resistance-coil of relatively high resistance at the central office and the other through the circuit of the normally closed pairs of contacts of the line to the ground at the subscriber's station. The test receiving instruments are so adjusted to the circuits and the battery that when the line is neither switched nor the subscriber's telephone is switched for use the instrument will sound or respond. It is, however, so adjusted that either when the line is switched for conversation and the derived circuit to ground at the subscriber's station is thereby opened or the subscriber's telephone is switched for use and the condenser is thereby included in the line-circuit, (in either case opening to battery-currents the derived circuit in which they are included,) and therefore increasing the resistance of the closed circuit in which the test instrument and battery are included, there will not be sufficient current passing through the instrument to cause it to be operated, although there will be some current passing through it which will tend to cause it to operate.

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 this 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 a subscriber's telephone being on or off its switch confusion frequently occurs from the fact that a subscriber places his telephone on its switch 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 this 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 com-

bines 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, from the office ground through a test receiving instrument and battery to a test contact-plug, and thence to a line-contact when the test is applied; thence in one direction to the office ground through a comparatively high resistance, and in the other direction to the subscriber's ground through a pair of switch contact-points in the central office and the subscriber's-station apparatus, in combination with a switch-plug which separates said pair of contact-points while it switches the line and a condenser and a switch apparatus and circuits at the subscriber's station to switch said condenser into the circuit of the line when the telephone is switched for use, and thereby practically open the line-circuit to battery-currents, said test receiving instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength, and said instrument and battery being adjusted to each other and to the several resistances and the circuits to the degree that the instrument sounds when, on the test being made, neither the telephone nor the line is switched for use and not otherwise, substantially as set forth.

2. A test-circuit for a subscriber's line, from the office ground through a test receiving instrument and battery to a test contact-plug, and thence to a line-contact when the test is applied, thence in one direction to the office ground through a comparatively high resistance and in the other direction to the subscriber's ground through a series of pairs of switch contact-points, one on each of several boards, in combination with switch-plugs adapted to be inserted into the switches for switching and when a plug is inserted into a switch to separate its pair of contact-points while the line is thus switched for use, and a condenser and switch apparatus and circuits at the subscriber's station to switch said condenser into the line-circuit while his telephone is switched for use, and thereby practically open the line-circuit to battery-currents, said instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength, and said instrument and battery being adjusted to each other and to the several resistances and the circuits to the degree that the instrument sounds when, on the test being made, neither the telephone nor the line is switched for use, but not otherwise, substantially as set forth.

3. A test-circuit for a subscriber's line, from the office ground through a test receiving instrument to a test contact-plug, and thence to a line contact-point when the test is applied, thence in one direction to the office

ground through a comparatively high resistance, and in the other direction to the subscriber's ground through a pair of switch contact-points in the central office and the subscriber's-station apparatus, and a battery in the circuit, in combination with a switch-plug adapted to be inserted into the switch and when inserted to separate the contact-points while the line is switched for use, and a condenser and switch apparatus and circuits at the subscriber's station to switch said condenser into the circuit of the line when the telephone is switched for use, and thereby practically open the line to battery-currents, said test instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength, and said instrument and battery being adjusted to each other and to the several resistances and the circuits to the degree that the instrument sounds when, on the test being made, neither the telephone nor the line is switched for use, but not otherwise, substantially as set forth.

4. In a telephone-exchange system, a subscriber's line grounded at its outer end and having a condenser in its circuit in the station apparatus, while his telephone is switched for use, and a comparatively low resistance while it is not thus switched, a switch at the central office having a pair of contact-points normally in contact but separated while the line is thereby switched for use, 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 resistance-coil grounded on one side and connected on the other side to the line-circuit between the contact-points, and the test contact-piece, and a test receiving instrument with battery 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, said instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength, and said instrument being adjusted to the battery and the several resistances and the circuits to the degree that it sounds when, on the test being made, neither the subscriber's telephone nor the line is switched for use and not otherwise, substantially as set forth.

5. In a telephone-exchange system, a subscriber's line grounded at its outer end and having a condenser in its circuit in the station apparatus, while his telephone is switched for use, and a comparatively low resistance while the telephone is not thus switched, a series of switches at the central office for said line, one switch on each of several boards, each having a pair of contact-points normally in contact, but separated while the line is thereby switched, and a test contact-piece insulated from the rest (except by the circuit

connections), said line passing successively through its said pair of contact-points, and thence to said test contact-piece, in combination with a resistance-coil grounded on one side and connected on its other side to the line after it has passed through said pairs of contact-points, and a test wire or circuit containing a test receiving instrument and battery, 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, said instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength and said instrument being adjusted to the battery and the several resistances and the circuits to the degree that it sounds when, on the test being made, neither the subscriber's telephone nor the line is switched for use, but not otherwise, substantially as set forth.

6. In a telephone-exchange system, a subscriber's line grounded at its outer end and having a condenser in its circuit at his station apparatus, while his telephone is switched for use, and comparatively low resistance while it is not thus switched, in combination with a series of test contact-pieces, one piece on each of several boards, and normally connected to the line, switch contact-points which disconnect the line from its said contact-pieces while it is switched for use, a resistance-coil connected on one side to said contact-pieces and grounded on the other side, in combination with test receiving instruments, one at each board, each grounded on one side and connected on its other side to a test-plug adapted to be brought for testing into connection with the test contact-piece at its board, said instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength, and said instrument being connected in circuit with a battery and adjusted to it and the several resistances and the circuits to the degree that it will sound when, on the test being made, neither said telephone nor the line is switched for use and not otherwise, substantially as set forth.

7. In a telephone-exchange system, a subscriber's line grounded at its outer end and having a condenser in its circuit at his station, while his telephone is switched for use and comparatively low resistance while the telephone is not thus switched, multiple switchboards, switches for the line, each having a pair of contact-points normally closed but open while the line is switched at its board, test contact-pieces, one on each board, and a resistance-coil grounded on one side, said line passing successively through said pairs of contact-points and thence connected to said test contact-pieces and to the other side of said resistance-coil, in combination with test receiving instruments, one at each board, grounded on one side and connected on its

other side to a test plug or device adapted to be brought for testing into connection with the test contact-piece at its board, said instrument being adjusted to respond to current of certain strength, but not to respond to current of considerably less strength, and said instrument having a battery in circuit with it and adjusted to the battery and the several resistances and the circuits to the de-
5

gree that it will sound when, on a test being made, neither said telephone nor the line is switched for use and not otherwise, substantially as set forth.

MILO G. KELLOGG.

Witnesses:

FRANCES D. KELLOGG,
MARGARETHA RIEHL.