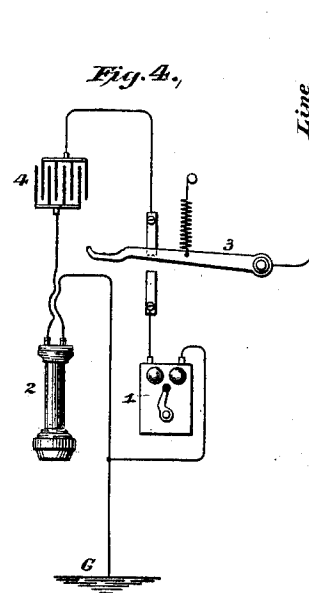
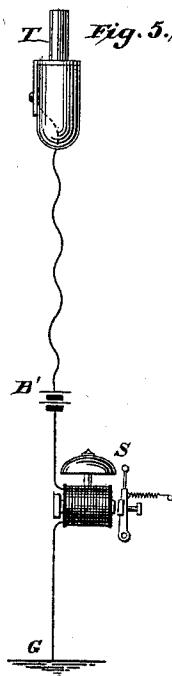
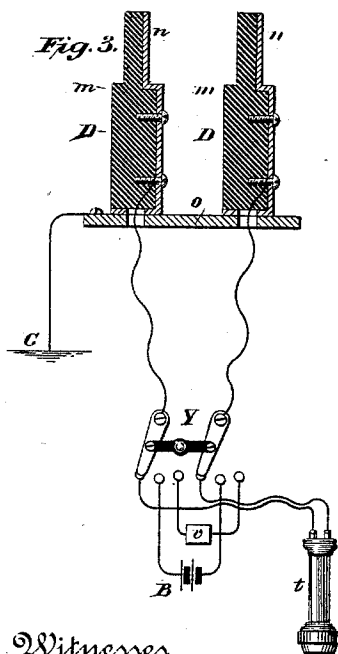
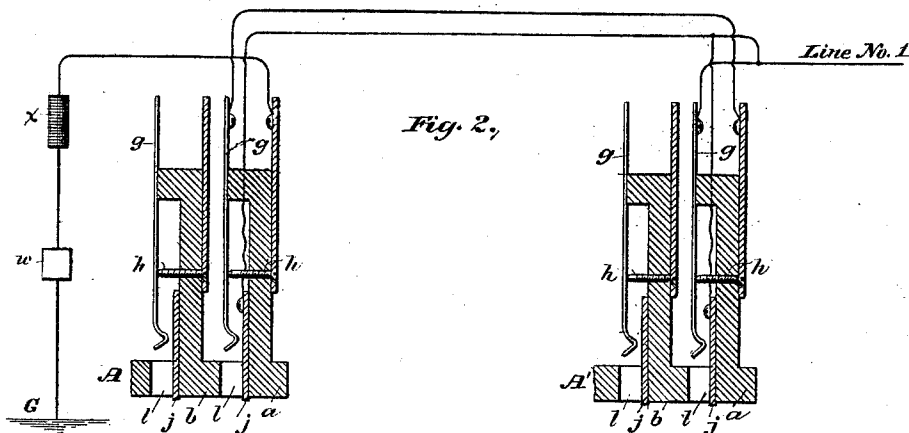
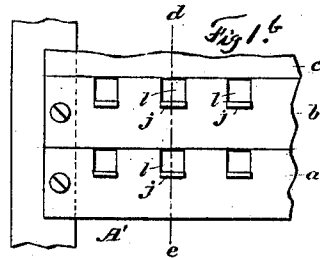


M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

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. 592,324, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,028. (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 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. Fig. 3 is a diagram of an operator's cord system to be used with the boards. Fig. 4 is a diagram of the subscriber's-station apparatus. Fig. 5 shows an operator's test system.

In the drawings like parts and apparatus are indicated by the same letters and figures of reference.

G represents the ground connection.

In Fig. 2, A is the 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 contact-piece of the plug.

In Fig. 2, *g g* represent the springs of the different switches, *h h* the contact-points, and *j j* the contact-pieces. *l l* are the switch-holes. *a b* are the rubber pieces on which the metal parts are mounted 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 when a plug is inserted to operate the switch, as above described. The contact-pieces *j j* should be so placed that a test-plug may be readily applied to them. Their function is to form test-pieces for their lines on the different boards, and they may be placed as shown or in other convenient positions on the boards.

The connections of the lines to the switchboards and apparatus are as follows and as shown for line No. 1: The line 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 and resistance-coil to the ground. *w* is the annunciator and *x* is the resistance-coil. The contact-pieces *j j* of a line are connected to the line, the connection being between the switch contact-points on the one hand and the subscriber's station on the other hand.

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 insulation 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 is in connection with the spring and is not in connection with the piece *j* of the switch. *o* is a metal strip on which the bases of the plugs normally rest and which then connects the contact-pieces with the ground. The circuits are as shown. The methods of connecting other cords to the system, as well as the method of operating the system in connection with the boards, will be apparent to those skilled in the art.

Each operator has one cord system and as many pairs of cords as she may need, and they are connected and mounted convenient for her use.

In the subscriber's-station apparatus shown in Fig. 4, 1 is the magneto-bell, containing a magneto-generator. 2 is the telephone. 3 is the telephone-switch, and 4 is a condenser of 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 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 instrument. *B'* is the test-battery, and *G* is the ground connection. They are connected as shown, and each operator has a test system suitably arranged and mounted for her work. The test receiving instrument and battery should be so adjusted to each other and the circuits that the instrument will sound or respond when the plug is placed on a test contact-piece *j* of a line and the subscriber's telephone is on its switch, (and the line is not open to the test-current by the condenser being in circuit,) and the circuit of the line is not open to the ground through the switch contact-points by the line being switched at one of the boards; but that the instrument will not respond or sound when either the test-circuit is open at the subscriber's station by the telephone being switched for use and the condenser being in the circuit or the circuit to the office ground is open by the line being switched at some board. In either case the resistance of the battery and instrument circuit is increased, and less current will pass through the instrument.

The adjustment described above is easy to obtain and depends on the fact that an electromagnet with an armature and a retractile spring acting on the armature may when closed in circuit with a battery and a certain resistance cause the armature to move, and when the resistance is considerably increased the strength of current will not be enough to cause the armature to move. The resistances of the circuits may be, for instance, such that the resistances of the telephone-lines when the subscribers' telephones are on their switches may be about three hundred ohms each, (not including the resistance through the switches and the annunciators and resistance-coils to the office ground,) and the resistance through the switches to the office ground may be about one hundred and fifty ohms. When a test-plug is then applied to the test-piece *j* of a line and the line is not switched at any board and the subscriber's telephone is not switched for use, the resistance from the test-plug through the two circuits (one to ground through the subscriber's station and the other to ground through the pairs of switch contact-points) will be, say, one hundred ohms. The test receiving instrument and battery are such that with this resistance the instrument will sound. If the circuit through any pair of switch-points is open (but the line is not connected with any other line) and the subscriber's telephone is not switched, the resistance from *j* to ground will be about three hundred ohms and the instrument will not sound. If when the line is in that condition the telephone is off the switch, the circuit

will at the condenser be practically open to the battery and the instrument will not sound. If two lines are switched together by the insertion of a pair of plugs in their respective switches and the telephones are switched for use, the circuit from the test-plug to the two subscribers' grounds will be practically open at the two condensers and the instrument will not sound. If the two lines are thus switched together and the telephones are not switched for use, the resistance from the test-plug to the two subscribers' grounds will amount to one hundred and fifty ohms and the instrument will not respond. If a line is not switched and the subscriber's telephone is switched for use and the test-plug is applied to one of its test-pieces *j*, the circuit to the subscriber's ground is practically open to the battery at the condenser and the resistance from the piece *j* to the office ground being about one hundred and fifty ohms the instrument will not sound. The amount of resistance in the line-circuits and in the ground-circuits may vary from the figures given above and adjustment and operation of the system, as indicated, still be easy to obtain.

If one plug of a pair is in the switch of a line when the line is tested and the other plug rests on the ground-plate *o*, and the subscriber's telephone is off from its switch enough current will not pass through the test-bell to operate it, because the ground connection of the line is practically open to battery-currents at the subscriber's condenser and because the circuit to ground at the central office through the pair of plugs and the ground-plate *o* will contain the operator's telephone outfit *t*, the resistance of which in ordinary forms of apparatus is so great as to prevent the test-bell from being operated. This resistance will generally be and may be made considerably greater than one hundred and fifty or two hundred ohms. The operator will therefore know when the apparatus is connected and adjusted as described when, on making the test of a line, the instrument sounds that neither the line is switched for use nor the subscriber's telephone is switched for use and that the line is "free," and when the instrument does not sound she knows that either the line is switched at the central office or that the operator's telephone is switched for use.

The resistance-coil *x* and the annunciator *w* for each line furnish resistance by which the desired adjustment and operation are obtained. The required resistance between the test-pieces and the office ground might all be included in the resistance-coil or all included in the annunciator, or might be included in other forms of resistance and might be of small amount.

In some systems of testing the lines test "busy" when they are switched at the central office, and in other systems they test "busy" when the subscriber's telephone is switched for use. In this system they test

"busy" whether they are switched at the central office or whether the subscriber's telephone is switched for use and will not become tied up. It combines the advantages and obviates the disadvantages of both the other general systems of testing.

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-plug, thence when the test is applied to a line-contact connected with the line between the subscriber's station and the pair of contact-points of his switch at the central office, thence in one direction to the office ground through said pair of contact-points normally in contact but open while the line is switched at their board, and in the other direction to the subscriber's ground through his station apparatus, in combination with a condenser at the subscriber's station and a switch to switch the condenser into the circuit of the line while the telephone is switched for use and out of said circuit while the telephone is not thus switched, substantially as set forth.

2. In a multiple-switchboard system a test-circuit for a subscriber's line, from the office ground through a test receiving instrument and battery to a test-plug, at any one of the boards, thence, when the test is applied, to a line-contact at the board where the test is made, thence in one direction to the office ground through all the pairs of contact-points of the line, one pair on each board, each pair normally in contact but open while the line is switched at their board, and in the other direction to the subscriber's ground through his station apparatus, in combination with a condenser at the subscriber's station and a switch with contact-points to switch the condenser into the circuit of the line while his telephone is switched for use and out of said circuit while it is not thus switched, substantially as set forth.

3. In a telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit at the subscriber's station a condenser when his telephone is switched for use but not otherwise, and at the central office a switch with a pair of contact-points normally in contact but open while the line is switched, 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 ground through a resistance and said contact-piece being connected to the line between its switch contact-points and the subscriber's station, in combination with a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument will sound, 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 at his station a condenser and a switch with contact-points to switch the condenser into the circuit of the line while his telephone is switched for use and to switch it out of the circuit while the telephone is not thus switched, and at the central office a switch with a pair of contact-points normally in contact but open while the line is switched by it, and a test contact-piece insulated from the rest (except by the circuit connections) said line passing through said pair of contact-points and to ground through a resistance and said contact-piece being connected to the line between its switch contact-points and the subscriber's station, in combination with a test wire or circuit containing a test receiving instrument and battery, grounded on one side and connected on the other side to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said test receiving instrument, battery and the circuits being so constructed and related that the instrument will sound when on a test being made neither the subscriber's telephone nor the line is switched for use but not otherwise, substantially as set forth.

5. In a multiple-switchboard telephone-exchange system, a subscriber's line grounded at its outer end and having at its subscriber's station a condenser in its circuit while his telephone is switched for use but not otherwise, in combination with a test contact-piece on each board at the central office separate from the other switch-contacts and separately connected to the line, a resistance in the circuit of the line between the connection of said test contact-piece and the normal office ground, switch contact-points which disconnect the line from the office ground while the line is switched for use and a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument 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.

6. In a multiple-switchboard telephone-exchange system, a telephone-line grounded at its outer end and at the subscriber's station a condenser and a switch with contact-points which switches the condenser into the circuit of the line while the subscriber's telephone is switched for use and out of the circuit while the telephone is not thus switched, in combination with a test contact-piece at each board at the central office separate from the other contacts of the switch and separately

connected to the line, a resistance in the circuit between said contact-piece and the office ground, switch contact-points which disconnect the line from the office ground while it is switched for use, and a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument will sound when on a test being made neither said telephone nor the line is switched for use but not otherwise, substantially as set forth.

7. In a telephone-exchange system, a telephone-line grounded at its outer end and having at its subscriber's station a condenser in the circuit of the line while it is switched for use but not otherwise, in combination at the central office with a series of pairs of switch contact-points, one on each of several boards, each pair normally in contact, and through which the line passes successively, to the office ground, each pair being open while the line is switched at its board, a test contact-piece at each board separate from the other switch-contacts and separately connected to the line, a resistance-coil in the circuit between the connection of said test contact-piece and the ground, and a test receiving instrument and battery in a test wire or circuit grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument will sound when on a test being made neither said telephone nor the line is switched but not otherwise, substantially as set forth.

8. In a telephone-exchange system, multiple switchboards, a telephone-line connected to the same and grounded at its outer end, and at the subscriber's station a condenser and a switch with contact-points which switch the condenser into the circuit of the line while the subscriber's telephone is switched for use and out of said circuit while the telephone is not thus switched, in combination with a series of switches for the line, one on each of the boards, each switch having a pair of contact-points normally in contact and the line passing normally through said pairs of contact-points and to ground, each pair of contact-points being open while the line is switched at their board, test contact-pieces, one on each board and each connected to the line between the switch contact-points and the subscriber's station, a resistance-coil in the circuit between the connection of the test contact-pieces to the line and its office ground, and a test receiving instrument and

battery for each board in a test wire or circuit grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument will sound when on a test being made neither the said telephone nor the line is switched for use but not otherwise, substantially as set forth.

9. In a telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit at the subscriber's station a condenser when his telephone is switched for use but not otherwise, and at the central office a switch with a pair of contact-points normally in contact but open while the line is switched, 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 ground, and said contact-piece being connected to the line between its switch contact-points and the subscriber's station, in combination with a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument will sound when on the test being made neither the telephone nor the line is switched for use but not otherwise, substantially as set forth.

10. In a telephone-exchange system, a telephone-line grounded at its outer end and having at its subscriber's station a condenser in the circuit of the line while it is switched for use but not otherwise, in combination at the central office with a series of pairs of switch contact-points one on each of several boards, each pair normally in contact, and through which the line passes successively to the office ground, each pair being open while the line is switched at its board, a test contact-piece at each board separate from the other contacts of the switch and separately connected to the line, and a test receiving instrument and battery in a test wire or circuit grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with said test contact-piece for testing, said instrument, battery and the circuits being so constructed and related that the instrument will sound when on a test being made neither said telephone nor the line is switched but not otherwise, substantially as set forth.

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