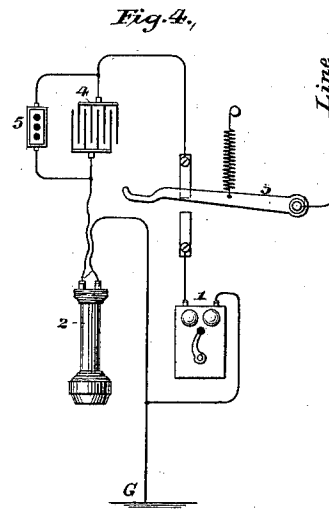
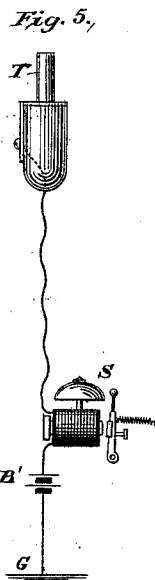
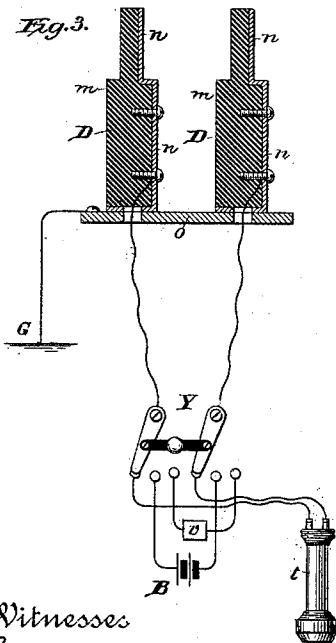
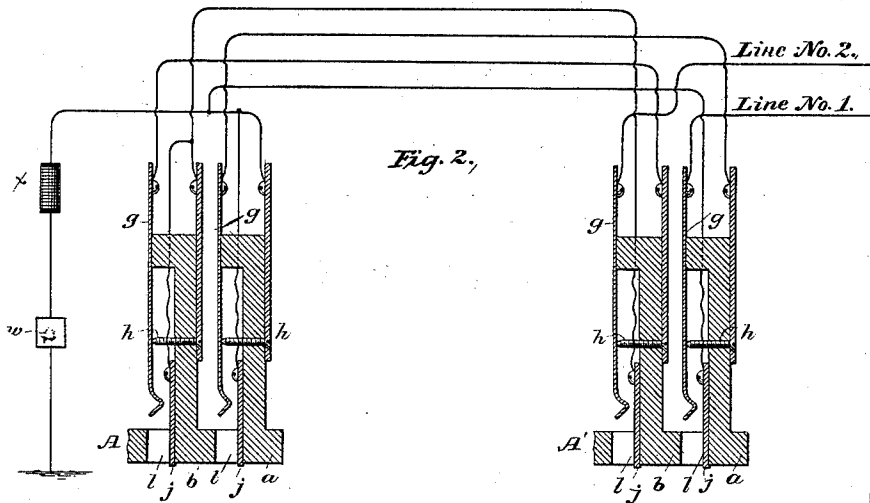
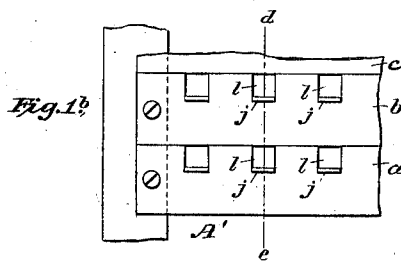
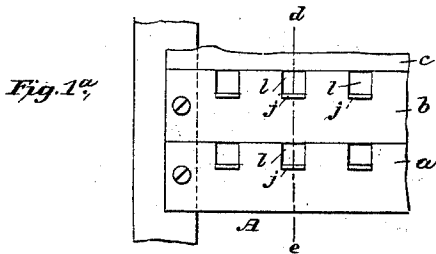


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,322.

Patented Oct. 26, 1897



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UNITED STATES PATENT OFFICE.

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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,322, dated October 26, 1897.

Application filed November 29, 1889. Serial No. 332,025. (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 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. Fig. 5 shows an operator's test system to be used at the boards.

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

G in each case represents 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 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 the 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. *ab* 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 positions on their boards.

The connection 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 its annunciator and a 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 switches 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 contact-points of its switches, is connected to the contact-pieces *j j* of its switches. Independent calling-circuits are generally used for such lines, such as the Law and American district systems. Line No. 1, as marked, shows the connection of a line normally grounded, and line No. 2 the connection 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, and operator's telephone and battery or generator. The plugs D D are constructed substantially as shown, *mm* being the rubber insulations and *nn* 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 strip 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 loop-

ing-in switch of the pair of cords. r is the clearing-out annunciator. t is the operator's telephone, and B is her calling-generator. The circuits are as shown.

- 5 The method of connecting other pairs of cords, with their accompanying apparatus, to the system, and the method of operating the system in connection with the switchboards, will be apparent to those skilled in the art.
- 10 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 magneto-generator. 2 is the telephone. 3 is the telephone-switch. 4 is a condenser of suitable capacity, and 5 is a resistance-coil of suitable resistance. The contact points and circuits are as shown or otherwise arranged so as to perform substantially the operations hereinafter described. The condenser and resistance-coil are in a derived or parallel circuit to each other, as shown, and the circuit which contains them is in the circuit of 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.

- 30 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. Each operator has one test system, and the parts are connected substantially as shown and are conveniently mounted for the operation of the system. The test receiving instrument and battery should be so adjusted to each other and to the circuits that the instrument will respond or sound when the test-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 boards, but will not sound when the line is switched or when the resistance is introduced into the circuit at the subscriber's station by the operator's telephone being switched for use. The resistance of the office ground connection of the line through the annunciator and resistance-coil should be made large enough so as not to produce enough current through the test receiving instrument to operate it when the line and the subscriber's telephone are not switched, as above indicated, or to operate the annunciator when the test is made. The amount of this resistance will depend on 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 resistance at the subscriber's station, which is introduced into the circuit of the line when his telephone is switched for use, should be sufficiently great so that the resistance of the line is then increased, so that the test receiving instrument will not then operate on the test being made.

The condenser bridges this resistance, so that the telephone-currents are not unduly impeded. The resistance bridges the condenser, so that the circuit will not be opened to calling-currents sent over it when the subscriber's telephone is switched for use—as, for instance, a clearing-out signal made by the other subscriber.

The system of testing is as follows: An operator, on testing, places the contact-piece T of her test system on the contact-piece j of the line to be tested. If the line is not switched at any board, a complete circuit is established from the ground through the test receiving instrument to the line and to ground at the subscriber's station. If his telephone is on its switch, the resistance of the circuit will be sufficiently low so that the test receiving instrument will sound, showing that the line is free. If, however, the telephone is switched for use, the resistance of the line is increased by the introduction of resistance, so that the instrument will not sound; and if the line is switched for use at the central office the test-circuit is interrupted; so that the test receiving instrument will not sound. When an operator makes a test and receives no response or sound, she therefore knows that the line is in use, either by the telephone being switched for use or by the line being switched for use, and she will not switch it with another line.

The test system depends on the fact that 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 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 decreased. 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 applied, 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, in either case increasing the resistance of 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. This test system therefore depends on a marginal adjustment of these parts to each other and to the resistances to secure the sounding of the test receiving instrument when neither the line nor the subscriber's telephone is switched for use and to insure that it does not sound when either is switched for use.

The resistance-coil furnishes the additional resistance required in the circuit when the subscriber's telephone is switched for use to provide for the marginal adjustment and operation of the test system as described, while the condenser provides an easy circuit or path for the passage of the telephone-currents. The resistance-coil moreover provides an all-metallic circuit through the subscriber's line for the passage of the clearing-out currents, especially when one subscriber sends the clearing-out signal while the other subscriber has not yet placed his telephone on his switch, as may often be the case.

With the forms of apparatus used in telephone-exchanges the clearing-out signal will be readily operated over the resistances necessary to produce the marginal adjustment of the test system which has been so 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 require some time before she can switch to a line and answer its call. In systems which depend 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 the 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 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 switched for use. The system therefore combines the advantages

and obviates the disadvantages of the two general systems of testing outlined above.

The line-annunciators will be so related to the test-batteries that they will not be made to indicate when an annunciator and battery are closed to each other on a test being made. For this purpose the annunciators may be polarized and so connected with reference to the batteries that the batteries will not operate them, or they may not be of sufficiently sensitive construction to be operated by the test-batteries.

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 switch apparatus and circuits at the subscriber's station to switch apparatus of comparatively high resistance shunted by a condenser into the circuit of line when the telephone is switched for use, and low resistance when it is not thus switched, 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 said 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 said pair of contact-points while the line is thus switched for use, and a switch apparatus and circuits at the subscriber's station to switch apparatus of comparatively high resistance shunted by a condenser into the line-circuit while his telephone is switched for use, and of comparatively low resistance while it is not thus switched, 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 said sev-

eral 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 switch apparatus and circuits at the subscriber's station to switch apparatus of comparatively high resistance shunted by a condenser into the circuit of the line when the telephone is switched for use, and of comparatively low resistance when it is not thus switched, 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 said 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.

4. In a telephone-exchange system, a subscriber's line grounded at its outer end and having in its circuit, in the station apparatus, a comparatively high resistance shunted by a condenser, 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 said 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 in its circuit in the station apparatus, a comparatively high resistance shunted by a condenser 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 said 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 in its circuit at his station, apparatus of comparatively high resistance shunted by a condenser 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 said 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 in its circuit at his station, apparatus

of comparatively high resistance shunted by a condenser, while his telephone is switched for use, and comparatively low resistance while the telephone is not thus switched, 5 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 10 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 15 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 20 to respond to current of considerably less strength, and said instrument having a battery in circuit with it and adjusted to the battery and said several resistances and the circuits to the degree that it will sound when, 25 on a test being made, neither said telephone nor the line is switched for use, and not otherwise, substantially as set forth.

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Witnesses:

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