(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,352. Patented Oct. 26, 1897.

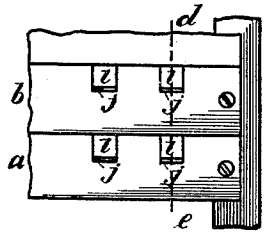


Fig. 1.a

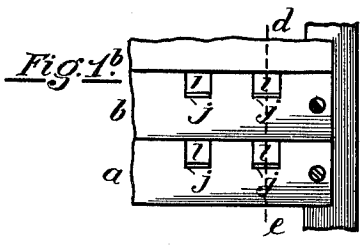


Fig. 1.b

Fig. 2.

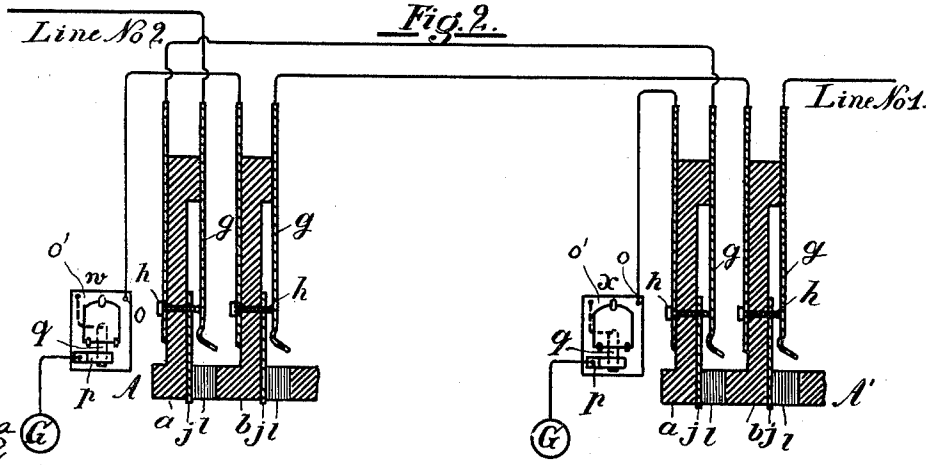


Fig. 2a

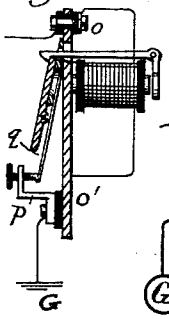


Fig. 3.

Fig. 4.

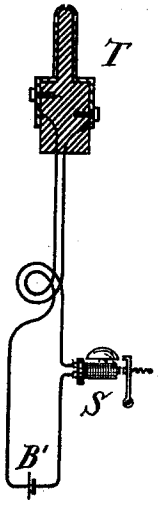
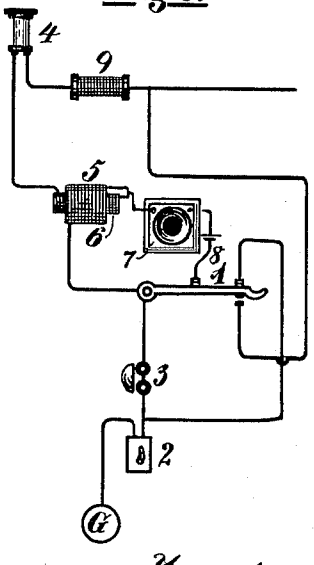


Fig. 5.



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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. 592,352, dated October 26, 1897.

Application filed January 4, 1890. Serial No. 335,860. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, in the county of Cook and State of 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 telephone-exchange system in which the lines are grounded at their outer ends; and it consists of a system of testing the lines to determine whether they are in use.

In the drawings illustrating my invention, Figures 1^a and 1^b represent sections of two multiple switchboards of the exchange to which the same lines are connected. Fig. 2 shows a diagram of the boards with the main-line apparatus and connections necessary to illustrate my invention. Fig. 2^a is a detail view of one of the line-annunciators. Fig. 3 shows a diagram of an operator's cord system to be used in connection with the boards. Fig. 4 shows an operator's test system to be used at the boards. Fig. 5 shows a subscriber's-station apparatus.

G represents in each case 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*.

I place as many boards in the central office as are found necessary or desirable in order to properly operate the exchange. On each board is a spring-jack or other suitable switch for each line. Each switch has a contact-spring which normally connects with a contact-piece insulated, except by the circuit connections, and is adapted to receive a loop-plug and, when a plug is inserted, to disconnect the spring from the contact-piece and connect the two contact-pieces of the plug with the spring and said insulated contact-piece, respectively. The switch is also adapted to receive a single-contact switch-plug and, when a plug is inserted, to disconnect the spring from the contact-piece and connect the spring with the contact-piece of the plug. In the construction of the switches as shown and as will hereinafter be described I prefer to have a contact-point electrically connected with the contact-piece and on which the spring normally bears, as there is less chance of poor connection when the spring bears on a point than when it bears on a surface adapted to be brought into connection with the plug-contacts.

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 contact-pieces of the switches connected with the points *h h*. *l l* are the switch-holes. *a b* are the rubber strips on which the metal parts of the switches are mounted, as shown, and through the fronts of which are the switch-holes *l l*. The contact-pieces *j j* are so placed along one of the surfaces of the plug-holes as readily to form connection with one of the contact-pieces of the loop-plugs.

The holes *l l* 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 raises the spring *g* from the contact-point *h* and the spring *g* and contact-piece of the plug are in contact. These holes are also adapted to receive the loop-plug shown in Fig. 4, and when a plug is inserted into a hole it raises the spring of the switch from the contact-point *h* and the spring *g* and the contact-piece *j* of the switch are in contact with the two contact-pieces of the plug, respectively.

w and *x* are calling-annunciators, one for each of the lines shown. Each annunciator has a pair of contact-points normally (or when the annunciator does not indicate a call) in contact with each other, but which are separated by the annunciator while it indicates a call. The two contact-points of a pair are marked *p* and *q*, respectively. One of them, *q*, is a spring-contact, which is pressed by the annunciator-drop when the drop falls away from its corresponding contact-point *p*. The contact-point *p* is represented as an angle-piece which passes over the spring *q* and is in contact with the spring when the spring is not actuated by the annunciator-drop.

The annunciator is shown in detail in Fig.

2^a. The line runs to an insulated bolt *o* at the top of the annunciator-plate *o'*, thence through the annunciator-coil to the plate, and thence normally through spring *q*, which is in electrical contact with the plate to the insulated angle-piece *p*, against which spring *q* normally bears, and thence to earth.

Two lines are shown in the drawings, one marked line No. 1 and the other line No. 2. These lines are ordinary single-circuit lines grounded at their outer ends and having at the subscribers' stations any usual and appropriate subscriber's-station apparatus. Each line passes successively through the pairs of contacts of its switches on the several boards, passing to each spring first. It then passes through its line-annunciator and the pair of contact-points of the annunciator to the ground. The circuit of each line shown may thus be traced in Figs. 2 and 2^a.

In the operator's cord system shown in Fig. 3, D D are the switch-plugs of a pair of cords, *n n* are the rubber insulations of the plugs, and *m m* are their contact-pieces. These contact-pieces pass each to the bottom of its plug and are adapted to rest normally, or, when the plug is not in use, on the metal piece *o*, which then connects it with the ground. Weights, as is usual, or similar devices may be used to bring the contact-pieces of the plugs into contact with the piece *o* and secure a good connection. These plugs are adapted to be inserted into any of the switches at their board, and when a plug is inserted it operates the switch as above described. The plugs should be inserted so that the contact-piece *m* is in contact with the spring *g*. The connections of the lines might have been reversed, so that the lines pass first to the contact-piece *j* of each of their switches, and in that case the plugs should be inserted in such a position that their contact-pieces form connection with the pieces *j* of the switches.

Y is the looping-in switch for the pair of cords shown.

k is the calling-key.

C is a condenser, and *v* is a clearing-out annunciator.

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

The circuits are substantially as shown. The two contact-pieces of the plugs are connected by flexible conductors to the two levers, respectively, of the looping-in switch. One of the pairs of contact-bolts of the switch are connected together through the clearing-out annunciator, and the other pair are connected through the operator's telephone. The lever of the calling-key is connected to one of the cords and the point of the key is grounded through the calling generator or battery. The condenser is placed in the circuit of the other cord of the pair.

The operation of the system in connection with the switchboards will be apparent to those skilled in the art. It will readily be apparent that when a line is switched by the insertion of a plug into its switch the line is disconnected from its normal ground at the central office and is connected into a circuit with the pair of cords and that the condenser of the pair of cords is in its circuit. Only one pair of cords is shown, but the connection of such other pairs, with their accompanying apparatus as the operator may need, will be apparent to those skilled in the art. To each pair of cords with its plugs belong a looping-in switch, a condenser, a clearing-out annunciator, and a calling-key. One telephone and one calling-generator will answer for her system of cords. The plugs should be inserted into the switches of the line, so that the calling-key is connected to the circuit of the cords between the condenser and the switch-plug inserted into the line whose bell it may be desired to ring. If desired, two calling-keys may be used for each pair of cords, one connected on each side of the condenser.

In the operator's test system shown in Fig. 4, T is a loop test-plug adapted to be inserted into any of the switches and, when inserted, to operate them as heretofore described. B' is a test-battery, and S is a test receiving instrument. The battery and instrument are connected in a loop which terminates in the two contact-pieces of the plug.

Each operator has one cord system and one test system, and they are conveniently mounted and arranged for her work.

In the subscriber's-station apparatus shown in Fig. 5, 1 is the telephone-switch. 2 is the calling-generator. 3 is the signal-receiving bell. 4 is the subscriber's telephone. 5 is the secondary, and 6 is the primary, of the induction-coil. 7 is the transmitter. 8 is the transmitter-battery. 9 is a resistance-coil of suitable resistance to operate as hereinafter described. These parts may be of usual forms of apparatus and are connected as shown or in other ways, so as to perform practically the operations required and the operations hereinafter described. The line passes through the resistance-coil 9, thence through the telephone and the secondary and primary of the induction-coil to the lever of the switch, and thence through the signal-bell and calling-generator to ground. A circuit-wire of small resistance passes from the line between the subscriber's station and the resistance-coil to a contact-point against which the switch-lever is in contact when the telephone is on the lever. Another wire of small resistance passes from the circuit between the signal-bell and the office ground to a contact-point against which the lever comes in contact when freed from the weight of the telephone. A third circuit-wire passes from the connection between the primary and secondary of the induction-coil through the transmitter and battery to a contact-point against which the switch-lever comes in con-

tact when relieved of the weight of the telephone.

When the subscriber's telephone is on its switch, the signal-receiving bell is in the direct circuit of the line and the telephone, the secondary of the induction-coil, and the resistance-coil are shunted by a wire of small resistance, so as to be practically out of the circuit. When the telephone is off the switch, the telephone, the secondary of the induction-coil, and the resistance-coil are in the circuit and the signal-bell being shunted is practically out of the circuit. The resistance of the telephone and secondary of the induction-coil combined aggregrate in well-constructed apparatus about four hundred ohms and the resistance of the signal-bell amounts to about one hundred ohms. The resistance switched into the circuit when the telephone is off its switch for use is therefore much greater than is the resistance in the circuit when the telephone is in its normal position on the switch. I utilize this difference in resistance in the operation of the test system, as will hereinafter appear. If the difference in the resistance when the telephone is off its switch for use and when it is in its normal position on the switch is not sufficient to secure an easy adjustment of the test apparatus to the circuits, such additional resistance as is required may be placed in the resistance-coil 9. Whether this artificial resistance is used, and its amount, if used, will depend on the apparatus and circuits to which the system may be applied. The test receiving instruments and test-batteries are then so constructed and adjusted to each other and the circuits that the instrument will sound or respond when it and its battery are looped into the closed circuit of any single line and the subscriber's telephone is not off its switch for use, but will not respond if the circuit is open at any point, or if the subscribers's telephone is off its switch and the additional resistance at the subscriber's station is included in the circuit, or the line is switched with another line and thereby has its test-circuit open, as will hereinafter be indicated. This adjustment can be regulated as required by the addition of artificial resistances in the circuits. This construction and adjustment depend on the fact that an electromagnet may be readily made, so as to operate when a battery and a certain resistance are in circuit with it and not to operate when the resistance is considerably larger. This operation can be obtained in different ways, dependent on the style of the electromagnet, the number of convolutions of its coil, the size of the battery, and the adjustment of the retractile spring. These parts should be such that the electromagnet will be actuated when the test system is looped into the single circuit of any line of the exchange, but will not be actuated when the additional resistance is introduced. The resistance of the coils may be such as is necessary or desirable in order to obtain such an adjustment of the parts of the exchange system.

The operation of the test system is as follows: When an operator desires to test a line, she places her test-plug into the switch of the line and by so doing disconnects the points *g* and *j* of the switch and connects them with the contact-pieces of the plug. If, then, the line is not switched at any board and the annunciator does not indicate a call and the subscriber's telephone is on its switch, the test receiving instrument will sound or respond, indicating that the line is free to be switched to. If, however, the line not being switched, the subscriber has sent in a call and the annunciator indicates the call, or the subscriber has taken his telephone from the switch for use, the instrument will not sound, as the line being open at the annunciator points, or the additional resistance in the circuit will prevent it from doing so. If, again, the line is switched at some board and the test is made in the cut-off portion of the line—that is, that portion which is between the switch used for switching and the office ground—the instrument will not sound because the test-circuit is open at the pair of contact-points of the switch used for switching. If, again, the line is switched at any board with another line and the test is made in some switch between the one used for switching and the subscriber's station, the instrument will not sound on account of the test-circuit being open at the condenser.

When a test of a line is made and the test receiving instrument sounds, the operator knows that neither the line is switched for use nor the subscriber's telephone is switched for use nor the line, annunciator indicates a call, and when the instrument does not sound she knows that either the annunciator indicates a call or the subscriber's telephone is switched for use or the line is switched for use, and she will not connect the line with any other line.

By this system a subscriber's line is reserved to himself from the time he sends in his call or takes his telephone down for use.

In this system only two switch-contacts are required for each line on each board instead of three or more, as in other systems with ground-circuit lines, and there are only two leading-in wires to each switch instead of three or more, as in other systems. There is also but one wire required for each line for the connection between her boards instead of two or more, as in other systems.

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

1. In a telephone-exchange system, a telephone-line normally passing successively through pairs of switch contact-points, one pair on each of several boards, each pair normally closed, but open while the line is switched at their board, and through an an-

nunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, in combination with switching devices at each board to disconnect said pair of contact-points at the board and switch the line for conversation with a condenser in the circuit when the line is thus switched and only then in circuit with the line, apparatus and switching devices at the subscriber's station to include a greater resistance in the circuit of the line while the subscriber's telephone is switched for use than when it is not thus switched, and a loop test-plug in the two contact-pieces of which terminate the two sides of a loop containing a test receiving instrument and battery, said plug being adapted to be inserted into one of the switches and when inserted to disconnect its said contact-points which are normally in contact and connect them with the contact-pieces of the plug, said test receiving instrument being so related and adjusted that it will sound when looped into the simple normal closed circuit of the line with the battery but will not sound while the circuit is open or the line has a condenser in circuit with it or the subscriber's telephone is switched for use and the additional resistance thereby included in the circuit, substantially as set forth.

2. In a telephone-exchange system, a telephone-line grounded at its outer end and normally passing successively through pairs of switch contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched at their board, and through an annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, and thence to the ground, in combination with switching devices at each board to disconnect said pair of contact-points at the board and switch the line for conversation with a condenser in the circuit with the line when it is thus switched and a condenser then only in circuit with it, apparatus and switching devices at the subscriber's station to include a greater resistance in the circuit of the line while his telephone is switched for use than when it is not thus switched, and a loop test-plug in the two contact-pieces of which terminate the two sides of a test-loop containing a test receiving instrument and battery, said plug being adapted to be inserted into one of the switches and when inserted to disconnect the contact-points of the switch which are normally in contact and connect them with the two contact pieces of the plug, said test receiving instrument and battery being so related and adjusted that the instrument will sound when they are included in the simple normal circuit of the line (the subscriber's telephone not being switched for use) but will not sound when included in circuit with the line and the circuit is open or the line has a condenser in circuit with it or the telephone is switched for use and the additional resistance thereby included in the circuit, substantially as set forth.

3. In a telephone-exchange system, a telephone-line normally on closed circuit and passing successively through pairs of switch contact-points, one pair on each of several boards, each pair normally in contact but open while the line is switched for conversation at their board, and through an annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, in combination with switching devices at each board to disconnect said pair of contact-points at the board and switch the line for conversation with a condenser switched into circuit when the line is thus switched and no condenser otherwise in circuit with it, apparatus and switching devices at the subscriber's station to include a greater resistance in the circuit of the line while his telephone is switched for use than when it is not thus switched, a loop test-plug in the two contact-pieces of which terminate the two sides of a loop which contains a test receiving instrument, said plug being adapted to be inserted into one of the switches and when inserted to disconnect the contact-points of the switch which are normally in contact and connect them with the contact-pieces of the plug, and battery in the circuit established on testing, said test receiving instrument and battery being so related that the instrument will sound when they are included in the simple normal circuit of the line but will not sound when the circuit is open at a pair of contact-points or through a condenser or when the subscriber's telephone is switched for use and the additional resistance is thereby included in the circuit, substantially as set forth.

4. In a telephone-exchange system, a telephone-line normally on closed circuit and passing successively through pairs of switch contact-points, one pair on each of several boards, each pair normally in contact but open while the line is switched for conversation at their board, and through an annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, in combination with switching devices at each board to disconnect said pair of contact-points at the board and switch the line for conversation with a condenser switched into circuit with it and no condenser otherwise in circuit with it, apparatus and switching devices at the subscriber's station to include a greater resistance in the circuit of the line while his telephone is switched for use than when it is not thus switched, and loop test-plugs, one at each board, each plug having two contact-pieces in which terminate the two sides of a loop which contains a test receiving instrument and battery, each loop-plug being adapted to be inserted into the switch at its board and when inserted to disconnect the said contact-points of the switch

which are normally in contact and connect them with the contact-pieces of the plug, each test receiving instrument and its battery being so related that the instrument sounds when they are included in the normal closed circuit of the line but will not sound when the circuit is open at any point or has a condenser in it or the subscriber's telephone is switched for use and the additional resistance is thereby included in the circuit, substantially as set forth.

5. In a telephone-exchange system, multiple switchboards, telephone-lines normally on closed circuit, switches for said lines, one switch on each board for each line, each switch having a pair of contact-points normally in contact but open while the line is switched at their board, each line passing normally successively through the pairs of contact-points of its switches on the several boards and through an annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, in combination with pairs of switch-plugs at each board, the contact-pieces of each pair being connected by a flexible-cord circuit containing a condenser, each of said plugs being adapted to be inserted into any switch at its board and when inserted to disconnect the pair of contact-points of the switch which are normally in contact and connect the line contact-point of the switch with the contact-piece of the plug, loop test-plugs, one at each board, each loop-plug having two contact-pieces in which terminate the two sides of a loop containing a test receiving instrument and battery, said plugs being each adapted to be inserted into any switch at its board and when inserted to disconnect the contact-points of the switch and connect them with the contact-pieces of the plug, and apparatus and switching devices at each subscriber's station to switch a greater resistance into the circuit of his line while his telephone is switched for use than when it is not thus switched, each test receiving instrument and its battery being so related that the instrument sounds when they are included in the normal closed circuit of any line but will not sound when the circuit is open at any point or has a condenser in circuit or the subscriber's telephone is switched for use and the additional resistance is thereby included, substantially as set forth.

6. In a telephone-exchange system, multiple switchboards, telephone-lines normally on closed circuit, switches for said lines, one switch for each line on each board, each switch having a pair of contact-points normally in contact but open while the line is switched at their board, each line passing normally successively through the pairs of contact-points of its switches on the several boards and through an annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, in combination with pairs of switch-plugs at each board, the two contact-pieces of each pair being connected by a flexible-cord circuit which contains a condenser, each of said plugs being adapted to be inserted into any switch at its board and when inserted to disconnect the pair of contact-points which are normally in contact and connect the contact-point which is connected with the line with the contact-piece of the plug, apparatus and switching devices at each subscriber's station to switch a greater resistance into the circuit of his line while his telephone is switched for use than when it is not thus switched, loop test-plugs, one at each board, each test-plug having two contact-pieces in which terminate the two sides of a loop which contains a test receiving instrument, each test-plug being adapted to be inserted into any of the switches at its board and when inserted to disconnect the contact-points of the switch and connect them with the contact-pieces of the plug, and battery in any test-circuit established on testing, each test receiving instrument and battery being so related and adjusted that the instrument sounds when they are included in the normal closed circuit of any line but will not sound when the circuit is open at any point or has a condenser in it or the subscriber's telephone is switched for use and the additional resistance is thereby included in the circuit, substantially as set forth.

7. In a telephone-exchange system, multiple switchboards, telephone-lines, each line grounded at its outer end, switches for said lines, one switch for each line on each board, each switch having a pair of contact-points normally in contact but open while the line is switched at their board, each line passing normally successively through the pairs of contact-points of its switches on the several boards and through an annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, and thence to the ground, in combination with pairs of switch-plugs at each board, the contact-pieces of each pair being connected by a flexible-cord circuit which contains a condenser, each plug being adapted to be inserted into any switch at its board and when inserted to disconnect said pair of contact-points of the switch and connect the point which is connected with the line with the contact-piece of the plug, apparatus and switching devices at each subscriber's station to switch a greater resistance into the circuit of his line while his telephone is switched for use than when it is not thus switched, and loop test-plugs, one at each board, each test-plug having two contact-pieces in which terminate the two sides of a loop which contains a test receiving instrument and battery, each test-plug being adapted to be inserted into any switch at its board and when inserted to disconnect the contact-points of the switch and connect them

with the contact-pieces of the plug, each instrument and its battery being so related and adjusted that when they are included in the normal closed circuit of any line the instrument will sound but will not sound if the circuit is open at any point or has a condenser in it or the subscriber's telephone is switched for use and the additional resistance is thereby included in the line, substantially as set forth.

In witness whereof I hereunto subscribe my name this 13th day of December, 1889.

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,

MARGARETHA RIEHL.