

(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,353.

Patented Oct. 26, 1897.

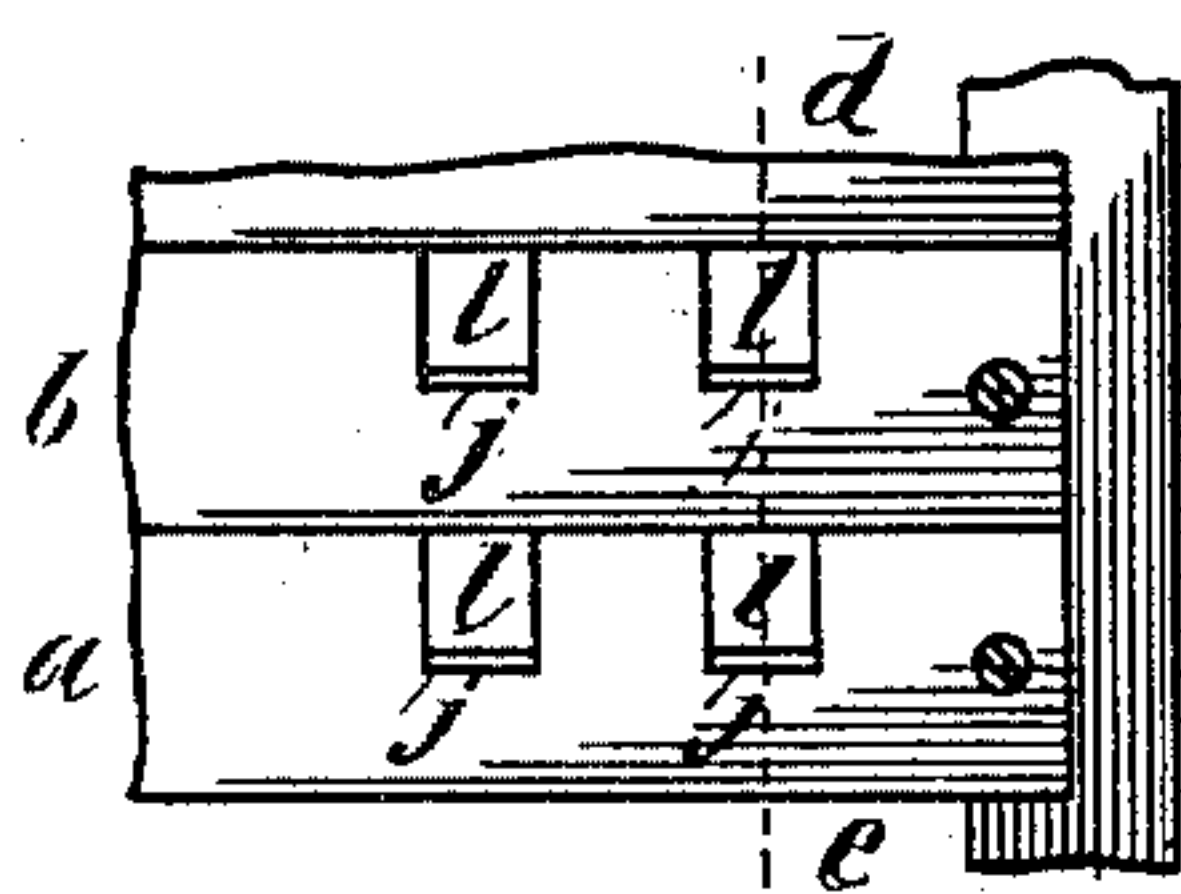


Fig. 1^a

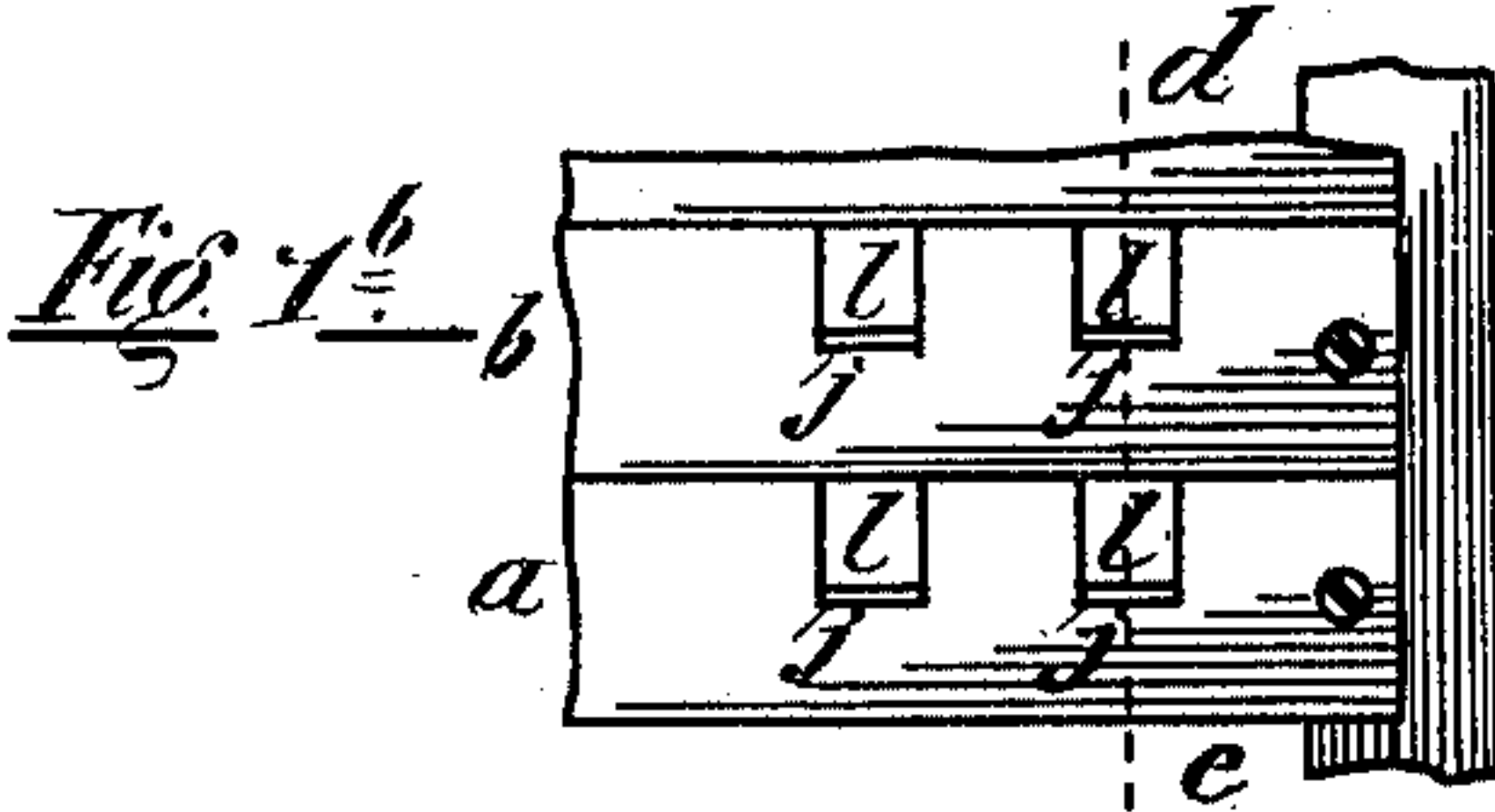


Fig. 1^b

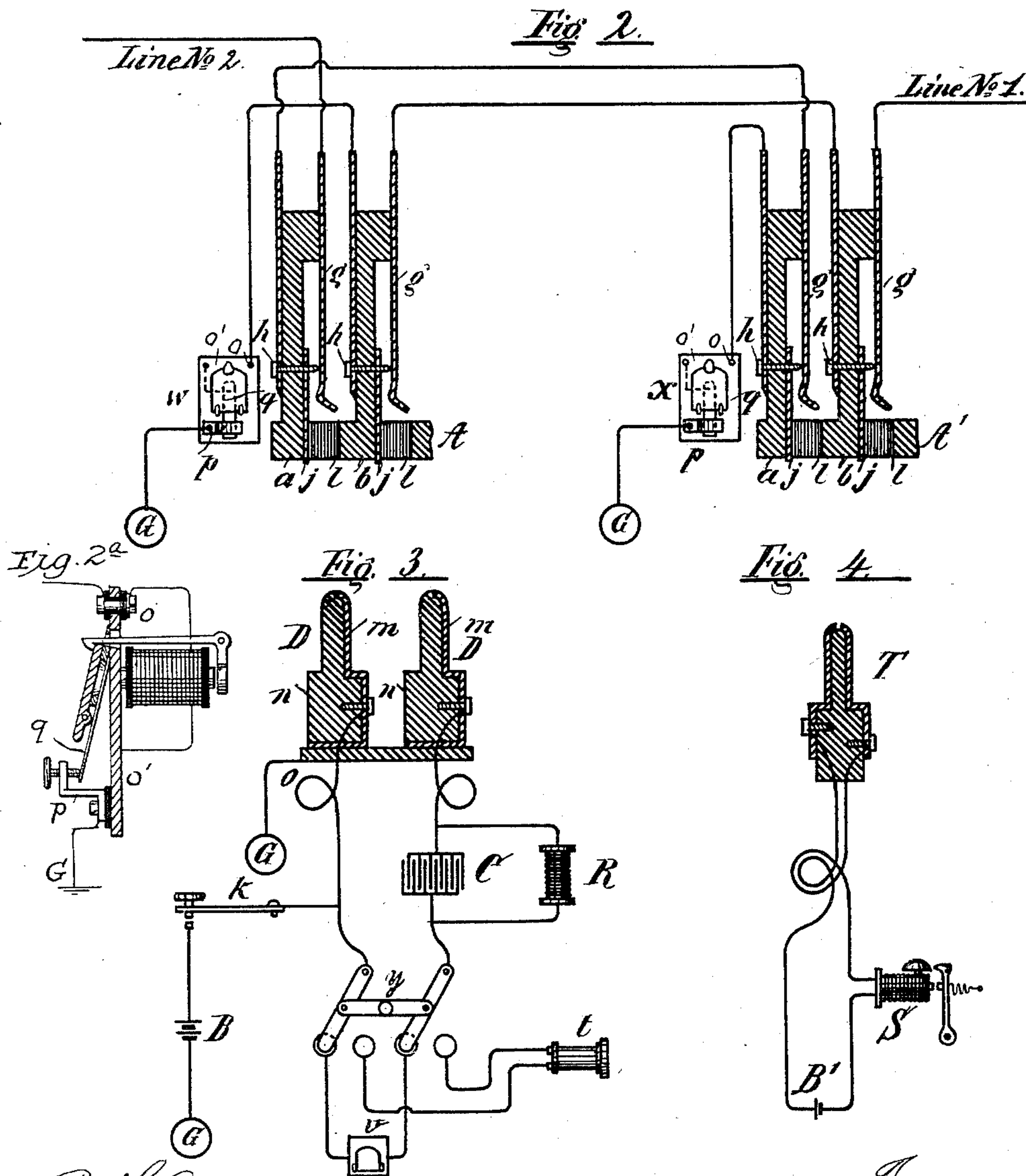


Fig. 2^a

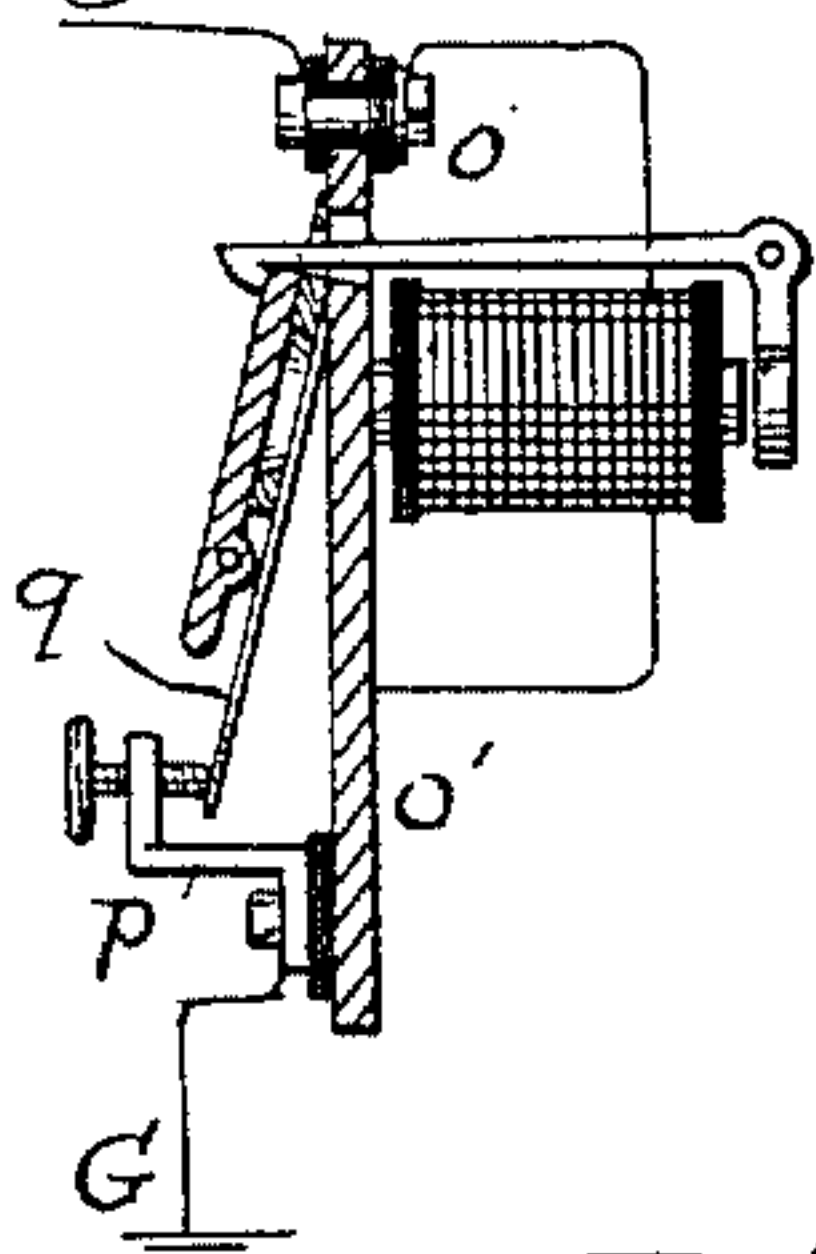


Fig. 3

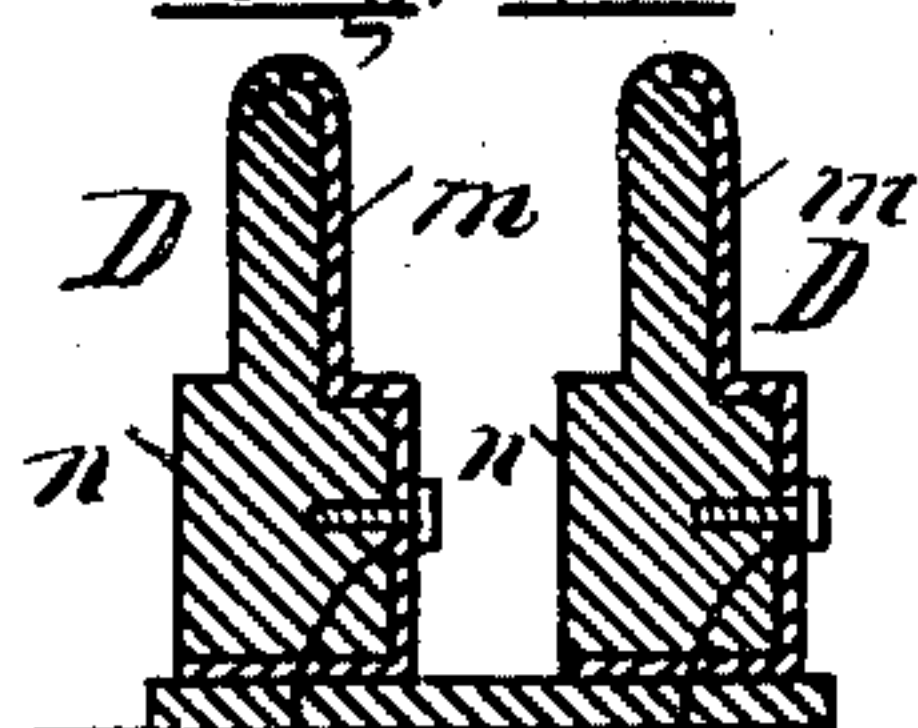
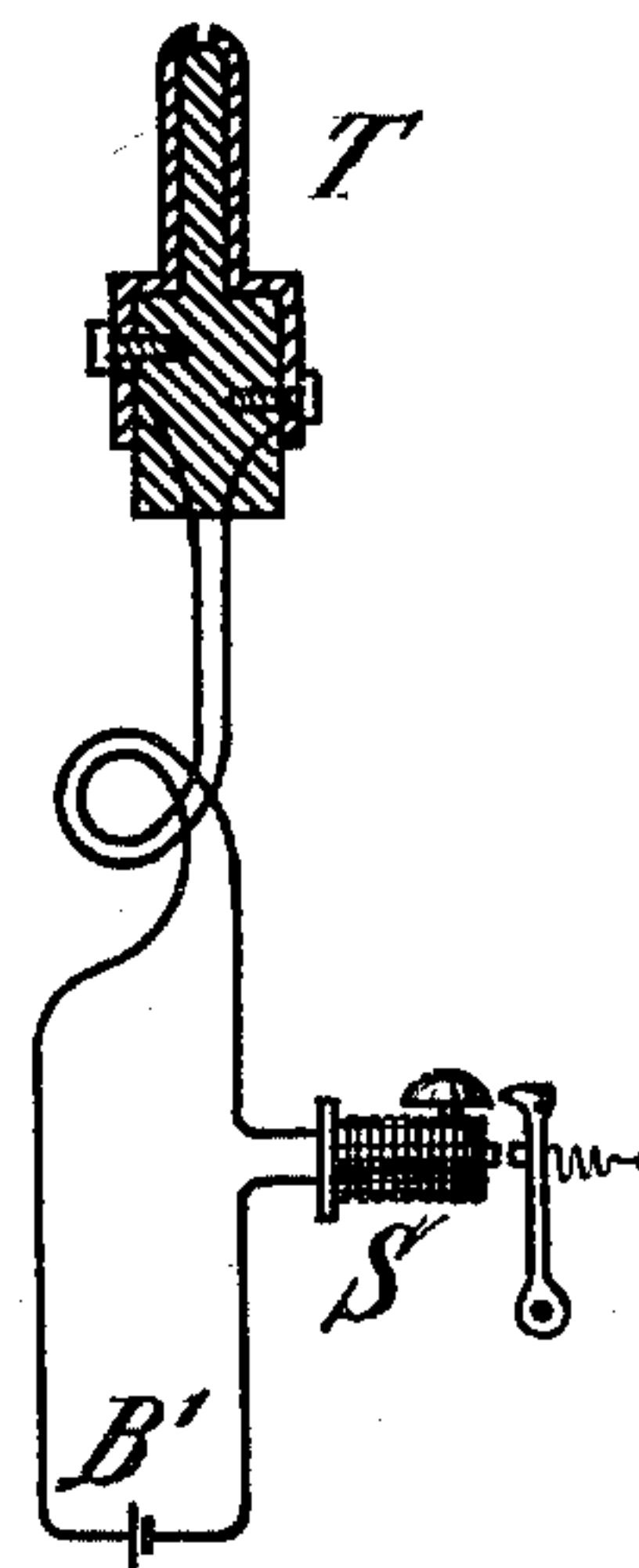


Fig. 4



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. 592,353, dated October 26, 1897.

Application filed January 4, 1890. Serial No. 335,862. (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 single-circuit lines, grounded at their outer ends; and it consists in apparatus for switching such lines of the exchange in the operation of the exchange system and 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.

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 an insulated contact-piece 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*, 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 in each case to the 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 Fig. 2.

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. *R* is a resistance-coil, 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 pair 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 and resistance in parallel with each other are 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 cir-

cuit with the pair of cords and that the circuit of the condenser and resistance-coil of the pair of cords is in its circuit. The condenser and the resistance-coil are connected in multiple or parallel circuit to each other, as shown. 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 resistance-coil, 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 lines, so that the calling-key is connected to the circuit of the cords between the condenser and resistance-coil 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.

The test receiving instrument and battery are so constructed and related to each other that when they are looped into the circuit with any line and the circuit is not open at some pair of contact-points and does not have the condenser and resistance-coil in its circuit, as described, the instrument will sound or respond, but when the circuit is open at any point or has a condenser and resistance-coil connected, as described, in it the instrument will not sound or respond. This construction depends on the fact that an electromagnet with an armature and a suitable retractile spring may be closed with a battery and a certain resistance and the armature be attracted, but when the resistance is considerably increased (or the circuit opened) the armature will not be moved. The condenser in the derived circuit offers a circuit for any telephone-current passing through the lines connected together which would otherwise be retarded by the convolutions of the resistance-coil. The resistance-coil affords a circuit for a clearing-out current sent through the circuit, which would, with the condenser only in circuit, be open to the clearing-out current.

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 pieces *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 switch and its annunciator does not indicate a call, the instrument and battery are on a closed circuit with the line and the instrument will sound or respond, indicating that the line is free to be connected to. If, however, the line-annunciator indicates a call, (and the line is not switched,) the circuit is open at the pair of annunciator contact-points and the instrument will not sound. If, again, the line is switched at any board when the test is made and the switch in which the test is made is in the cut-off portion of the line, or that portion which is between the switch used for switching and the office ground, the test-circuit is open at the pair of contacts *g h* of the switch used for switching and the test receiving instrument will not sound. If, again, the line is switched at any board and the test-plug is inserted into a switch which is between the one used and the subscriber's station, the test-circuit has the resistance of the condenser and resistance-coil in parallel circuit which is in circuit with the line and the instrument will not sound. When a test of a line is made and the test receiving instrument sounds or responds, the operator therefore knows that neither the line is switched for use at any board nor its annunciator indicates a call and that she may connect the line with another. When she makes the test and the instrument does not sound, she knows that either the line is switched for use at some board or its annunciator indicates a call and she will not connect it with another line. By this system of switching and testing a subscriber's line tests "busy" when it is switched and when his annunciator indicates a call. His line is reserved to himself as soon as he has sent in a call and will not be switched with another line before his operator has had time to answer his call, to his confusion and annoyance. In this system also there are only two contacts for each line on each board instead of three or more, as in other systems with ground-circuit lines, and there is only one wire leading in and one leading out from each switch instead of three or more in other systems. There is also but one wire between any two boards for each line 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 a pair of annunciator 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 resistance-coil and condenser in multiple or parallel circuit switched into the circuit, 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 loop-plug being adapted to be inserted into a switch and when inserted to disconnect said pair of contact-points of the switch which are normally in contact and connect them with the two contact-pieces of the plug, said battery and instrument being so related and adjusted that the instrument sounds when looped into the closed circuit of the line without the resistance-coil and condenser, but does not sound when the resistance-coil and condenser are included on 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 a pair of annunciator 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 the pair of contact-points at the board and switch the line for conversation with a resistance-coil and condenser in multiple or parallel circuit switched into the circuit, 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 a switch and when inserted to disconnect said pair of contact-points of the switch which are normally in contact and connect them with the two contact-pieces of the plug, said instrument and battery being so related and adjusted that the instrument sounds when they are looped into the closed circuit of the line, but does not sound when the resistance-coil and condenser are 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 closed but open while the line is switched at their board, and through a pair of contact-points of the line-annunciator normally in contact but open while the annunciator indicates a call, in combination with switching devices at each board to disconnect the pair of contact-points at the board and switch the line for conversation with a resistance-coil and condenser in multiple or parallel circuit then switched into the circuit, 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 the switches and when inserted into a switch to disconnect its said pair of contact-points and connect them with the two contact-pieces of the plug, said instrument and battery being so related and adjusted

that the instrument sounds when they are looped into the simple closed circuit of the line but will not sound when the resistance-coil and condenser are included, substantially as set forth.

4. In a telephone-exchange system, a telephone-line grounded at its outer end and passing normally 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 a pair of contact-points of the line-annunciator normally in contact but open while the annunciator indicates a call, and thence to the ground, in combination with switching devices at each board to disconnect the pair of contact-points at the board and switch the line for conversation with a resistance-coil and condenser in multiple or parallel circuit then included in the circuit, 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 the switches and when inserted into a switch to disconnect its said pair of contact-points and connect them with the two contact-pieces of the plug, and battery in the test circuit thereby established, said instrument and battery being so related and adjusted that the instrument sounds when they are looped into the simple closed circuit of the line but will not sound when the resistance-coil and condenser are switched into circuit with the line, substantially as set forth.

5. 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 closed but open while the line is switched at their board, and through a pair of contact-points of the line-annunciator normally in contact but open while the annunciator indicates a call, in combination with switching devices at each board to disconnect the pair of contact-points at the board and switch the line for conversation with a resistance-coil and condenser in multiple or parallel circuit then switched into circuit with it, 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 the switches and when inserted into a switch to disconnect its said pair of contact-points and connect them with the two contact-pieces of the plug, and battery in the test-circuit thereby established, said instrument and battery being so related and adjusted that the instrument sounds when they are looped into the simple closed circuit of the line but will not sound when the resistance-coil and condenser in multiple or parallel circuit are switched into circuit with the line, substantially as set forth.

6. In a telephone-exchange system, a telephone-line normally on closed circuit and hav-

ing in its circuit pairs of switch contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched for use at its board and having in its circuit a pair of annunciator 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 resistance-coil and condenser in multiple or parallel circuit then switched into circuit with it, and loop test-plugs, one at each board, each plug having two contact-pieces in which terminate the two sides of a loop containing a test receiving instrument and battery and adapted to be inserted into the switch of the line at its board, and when inserted to disconnect said pair of contact-points which are normally in contact and connect them with the two contact-pieces of the plug, each instrument and its battery being so related and adjusted that the instrument sounds when they are looped into the simple closed circuit of the line but will not sound when they and the resistance-coil and condenser are switched into circuit with the line, substantially as set forth.

7. In a telephone-exchange system, a telephone-line normally on closed circuit and having in its circuit pairs of switch contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched for use at their board, and having in its circuit a pair of contact-points of its annunciator, normally closed but open while the annunciator indicates a call, in combination with switching devices at each board to disconnect the pair of contact-points at the board and connect the line for conversation with a resistance-coil and condenser in multiple or parallel circuit then switched into circuit with it, 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 adapted to be inserted into the switch of the line at its board and when inserted to disconnect the pair of contact-points which are normally in contact and connect them with the two contact-pieces of the plug, and battery in the circuit established on testing, each instrument and the battery being so related and adjusted that the instrument sounds when they are looped into the simple closed circuit of the line but will not sound when they and the resistance-coil and condenser are switched into circuit with the line, substantially as set forth.

8. In a telephone-exchange system, multiple switchboards, telephone-lines, switches for said lines, one switch on each of the boards for each line, each switch having a pair of contact-points normally in contact but open while a switch-plug is inserted, line-annunciators, one for each line, each annunciator having a pair of contact-points normally in contact but open while the annunciator indicates

a call, each line passing successively through said pairs of switch contact-points of its switches and through its annunciator and the annunciator contact-points, in combination
 5 with pairs of switch-plugs at each board, the contact-pieces of each pair being connected by flexible conductors containing a resistance-coil and condenser in multiple or parallel circuit in their circuit, said plugs being adapted
 10 to be inserted into the switches at their boards and when inserted into a switch to disconnect the pair of contact-points of the switch and connect the line contact-point of the switch with the plug contact-piece, and loop
 15 test-plugs, one at each board, each plug having two contact-pieces in which terminate the two sides of a loop containing a test receiving instrument and battery and adapted to be inserted into any switch at its board and when
 20 inserted into a switch 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 looped into the
 25 simple closed circuit of any line the instrument will sound but will not sound when they and one of said resistance-coils with its condenser are in circuit with the line, substantially as set forth.

30 9. In a telephone-exchange system, multiple switchboards, telephone-lines, each line being normally on a closed circuit, switches for said lines, one switch on each of the boards for each line, each switch having a
 35 pair of contact-points normally in contact and open while a switch-plug is inserted into its line-annunciators, one for each line, each annunciator having a pair of contact-points

normally in contact but open while the annunciator indicates a call, each line passing
 40 normally successively through said pairs of contact-points of its switches on the several boards and through its annunciator and the contact-points of the annunciator, in combination with pairs of switch-plugs at each
 45 board, the contact-pieces of each pair being connected by a flexible conductor containing a resistance-coil and condenser in multiple or parallel circuit in the circuit, said plugs being adapted to be inserted into the switches
 50 at their boards and when a plug is inserted into a switch to disconnect the pair of contact-points of the switch and connect the line contact-point of the switch with the plug contact-piece, and loop test-plugs, one at each
 55 board, each plug having two contact-pieces in which terminate the two sides of a loop containing a test receiving instrument and battery, and adapted to be inserted into any switch at its board and when inserted to dis-
 60 connect 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 looped into the simple closed circuit of any
 65 line the instrument will sound but will not sound when the instrument and battery are included in the circuit of the line with any of said resistance-coils with its condenser, 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.