(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,346. Patented Oct. 26, 1897.

Fig. 1a

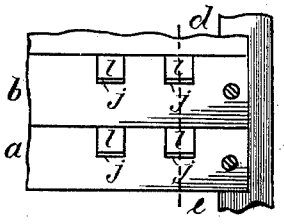


Fig. 1b

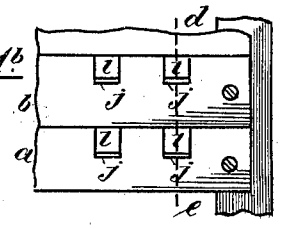


Fig. 2.

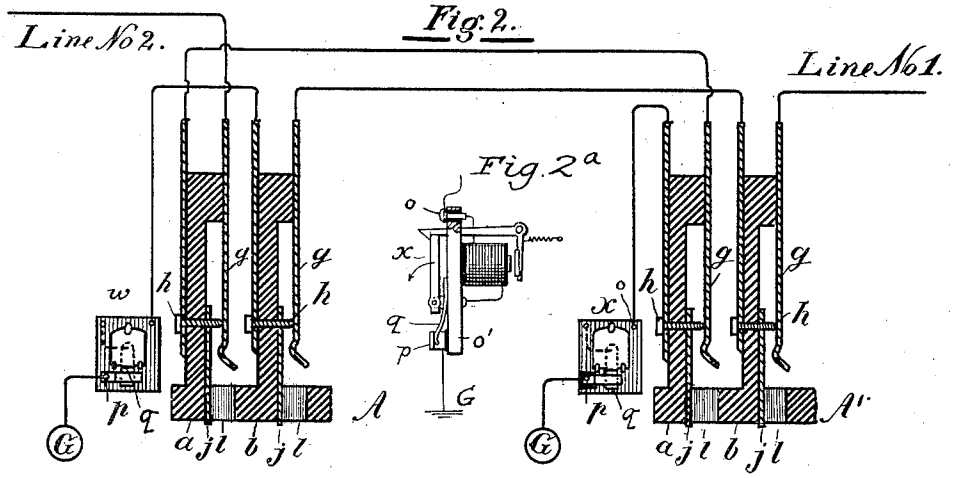


Fig. 3.

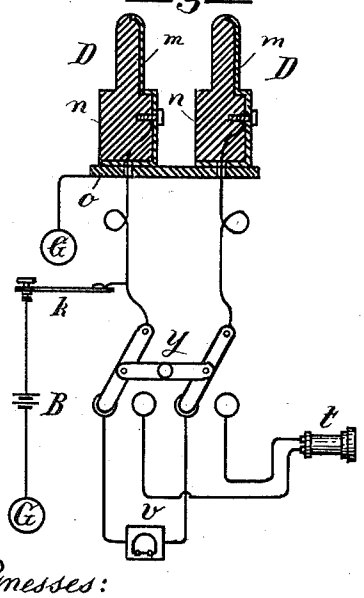


Fig. 4.

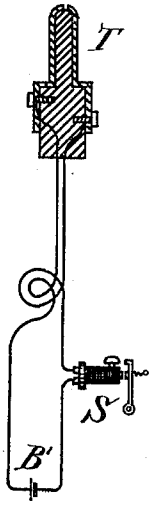
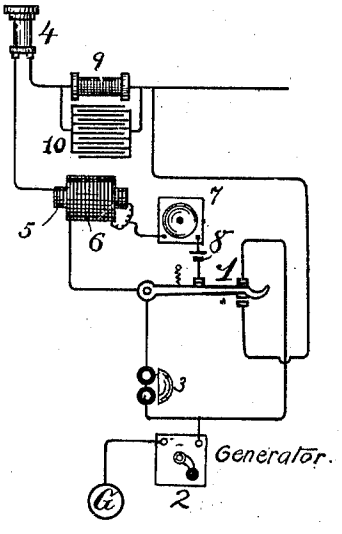


Fig. 5.



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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. 592,346, dated October 26, 1897.

Application filed December 31, 1889. Serial No. 335,533. (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 lines-grounded at their outer ends; and it consists of 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. 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 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.

2ª. 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 in each spring first. It then passes through its line-annunciator and annunciator-contacts 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 plug 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. 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. 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 Y, a clearing-out annunciator *v*, and a calling-key *k*. One telephone *t* and one calling-generator B will answer for her system of cords.

The two levers of the looping-in switch are connected by means of flexible conductors to the two contact-pieces of the switch-plugs. The contact-bolts of one of the pair of the switch-bolts are connected together through the clearing-out annunciator and the two other contact-bolts are connected through the operator's telephone. The lever of the calling-key is connected to the circuit of one of the cords and the contact-point of the key is grounded through the calling generator or battery.

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, and 9 is a resistance-coil of suitable resistance to operate as hereinafter described. 10 is a condenser. 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 circuit of a line, as shown in Fig. 5, is through the resistance-coil and condenser in multiple or parallel circuit, thence through the telephone and secondary and primary of the induction-coil to the switch-lever, and from the switch-lever to ground through the signal-receiving bell and calling-generator. From a point of the circuit before the line passes to the resistance-coil and condenser in derived circuit a circuit-wire of small resistance passes to a contact-point against which the switch-lever comes into contact when the telephone is on the switch. From a point of the circuit between the signal-bell and the ground another wire of small resistance passes to a contact-point against which the switch-lever comes into contact while the telephone is off the switch, and also from a point between the primary and secondary of the induction-coil a branch circuit passes through the transmitter and transmitter-battery to a contact-point against which the switch-lever comes into contact when the telephone is off the switch.

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 and condenser are shunted by a wire of small resistance, so as to be practically out of the circuit. When the telephone is off the switch, these instruments or parts are in the circuit and the signal-bell is practically out of the circuit. The resistance of the telephone and secondary of the induction-coil combined aggregate 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. The test receiving instruments and test-batteries are then so 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 subscriber's telephone is off its switch and the additional resistance at the subscriber's station is included in the circuit or the line is in circuit with another line, and thereby additional resistance is in the circuit with the line. This adjustment can be regulated as required by the addition of artificial resistance in the circuits. This construction and adjustment depends 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 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 subscriber has taken his telephone from the switch for use, the instrument will not sound, as 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, the instrument will not sound on account of the increased resistance of the circuit. 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, and when the instrument does not sound she knows that either 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.

It is evident that although I have shown a resistance-coil any kind of resistance may be used in its place to secure the desired results. The important point is that when a line is not switched for use at central there shall be a sufficient difference in the resistance of line in its switched and in its unswitched conditions to cause a variation in the signals of the test receiving instrument—that is, a test receiving instrument when looped into an unswitched line must sound when the telephone is not switched for use and must not sound when the telephone is switched for use. My invention herein described is broad enough to include any variation of resistance by which this differentiation of signals is obtained. The condenser being in multiple with the resistance-coil furnishes a ready path of low resistance for the passage of currents of a rapidly-alternating character. The resistence of the resistance-coil will not with ordinary forms of calling apparatus be sufficient to prevent the operation of the clearing-out annunciator when one subscriber places his telephone on its switch and operates his generator when the other subscriber has not yet replaced his telephone.

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

In the subscriber's apparatus shown in Fig. 5 when the telephone is on its hook the condenser and resistance are shunted and when the telephone is removed from its hook the shunt around the condenser and resistance are opened, and they are then directly in the line-circuit. In all classes of electrical apparatus the elimination of an element from the direct circuit is effected by positively cutting or switching it out of circuit or by shunting it. Obviously either plan may be adopted in this system, and the terms employed by me in the claims are intended to cover either plan.

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 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 the pair of contact-points at the board and switch the line with another line for conversation, a condenser and a resistance-coil in multiple or parallel circuit at the subscriber's station and a switch with contact-points to switch them into circuit while the subscriber's telephone is switched for use and out of the direct circuit with the line while the telephone is not thus switched, and a loop test-plug in the two contact-pieces of which terminate the two sides of a loop which contains a test receiving instrument and battery, said plug being adapted to be inserted into the switch at the board where it is located and when inserted to disconnect the pair of contact-points of the switch and connect them with the contact-pieces of the plug, said test receiving instrument and battery being so related that the instrument will sound when they are looped into the normal closed circuit of the line but will not sound when they are in an open circuit or are looped with a line which is switched with another line or has its subscriber's telephone switched for use, substantially as set forth.

2. 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 an annunciator and a pair of contact-points normally closed but open while the annunciatior indicates a call, and thence to ground, in combination with switching devices at each board to disconnect the pair of contact-points at each board and switch the line with another line for conversation, a condenser and a resistance-coil in multiple or parallel circuit at the subscriber's station and a switching device to switch said condenser and coil into the circuit of the line while the subscriber's telephone is switched for use and out of the direct circuit while the telephone is not thus switched, and a loop test-plug in the two contact-pieces of which terminate the two sides of a loop which contains a test receiving instrument and battery, said plug being adapted to be inserted into the switch at the board where it is located and when inserted to separate the pair of contact-points of the switch and connect them with the contact-pieces of the plug, said test receiving instrument and battery being so related that the instrument will sound when they are looped into the normal closed circuit of the line but will not sound when they are in an open circuit or are looped with the line when it is switched with another line or has its subscriber's telephone switched for use, 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 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 the pair of contact-points at the board and switch the line for conversation with another line, a condenser and a resistance-coil in multiple or parallel circuit at the subscriber's station and a switch with contact-points to switch said condenser and resistance-coil into the circuit of the line while the subscriber's telephone is switched for use and out of the direct circuit while the telephone is not thus switched, and a loop test-plug in the two contact-pieces of which terminate the two sides of a loop which contains a test receiving instrument and battery, said plug being adapted to be inserted into the switch at the board where it is located and when inserted to disconnect said contact-points of the switch and connect them with the contact-pieces of the plug, said test receiving instrument and battery being so related that the instrument sounds when they are looped into the normal closed circuit of the line but will not sound when they are in an open circuit or are looped with the line when it is switched with another line or has its subscriber's telephone switched for use, 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 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, in combination with switching devices at each board to disconnect the pair of contact-points at the board and switch the line with another line for conversation, a condenser and a resistance-coil in multiple or parallel circuit at the subscriber's station and a switch with contact-points which switch said condenser and coil in multiple or parallel circuit into the circuit of the line while the subscriber's telephone is switched for use and out of the direct circuit while the telephone 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 the switch at the board where it is located and when inserted to disconnect the contact-points of the switch and connect them with the contact-pieces of the plug, and battery in the test-circuit established on testing, said test receiving instrument and battery being so related that the instrument sounds when they are looped into the normal closed circuit of the line but will not sound when in an open circuit or looped with a line when the line is

switched with another line or has its subscriber's telephone switched for use, substantially as set forth.

5. In a telephone-exchange system, multiple switchboards, telephone-lines normally on closed circuit, switches for the lines, one switch on each board for each line, each switch having a pair of contact-points normally closed but open while its line is switched at its board, annunciators, one annunciator for each line, each line passing normally successively through the pairs of contact-points of its switches on the several boards and through the line-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 any pair of contact-points and connect their line with another line for conversation, a condenser and a resistance-coil at each subscriber's station and a switch at the station which connects them in multiple or parallel circuit in the direct circuit of the line while the subscriber's telephone is switched for use, and loop test-plugs, one at each board, each test-plug having a pair of 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 any switch at its board, and when inserted to disconnect the pair of contact-points of the switch and connect them with the contact-pieces of the plug, each test receiving instrument and battery being so related that the instrument sounds when they are looped into the normal closed circuit of any line but will not sound when in an open circuit or looped with any line which is switched with another line or has its subscriber's telephone switched for use, substantially as set forth.

6. 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 its line is switched at its board, annunciators, one for each line, each line passing normally successively through said pairs of contact-points of its switches on the several boards and through its annunciator and a pair of annunciator contact-points normally in contact 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, each plug being adapted to be inserted into any switch at its board and when inserted to disconnect the pair of contact-points of the switch and connect that point which is then connected with the line with the contact-piece of the plug, a condenser and a resistance-coil in multiple or parallel circuit at each subscriber's station and a switch at the station to switch said instruments in multiple or parallel circuit into the circuit of his line when his telephone is switched for use and out of the direct circuit when the telephone is not thus switched, loop test-plugs, one at each board, each test-plug having a pair of contact-pieces in which terminate the two sides of a loop which contains a test receiving instrument, each loop-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, and battery in any test-circuit established on testing, each test receiving instrument and battery being so related that the instrument sounds when they are looped into the normal closed circuit of any line but will not sound when they are in an open circuit, or are looped into circuit with any line which is switched with another line or has its subscriber's telephone switched for use, substantially as set forth.

7. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at their outer ends, switches for said lines, one switch for each line on each board, each switch having a pair of contact-points normally closed but open while the line is switched at its board, annunciators, one for each line, each line passing normally successively through the pairs of contact-points of its switches on the several boards and through its annunciator and a pair of contact-points normally closed but open while the annunciator indicates a call, and thence to ground, in combination with switching devices at each board to disconnect any pair of contact-points at the board and connect their line with another line for conversation, a condenser and a resistance-coil in multiple or parallel circuit at each subscriber's station and a switch which connects them into the circuit of his line while his telephone is switched for use and out of the direct circuit while the telephone is not thus switched, and loop test-plugs, one at each board in the two contact-pieces of 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 any switch at its board and when inserted to disconnect the pair of contact-points of the switch and connect them with the contact-pieces of the plug, each test receiving instrument and battery being so related that the instrument sounds when they are looped into the normal closed circuit of any line but will not sound when they are in an open circuit or are in circuit with a line which is switched with another line or has its telephone switched for use, 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.