(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,360. Patented Oct. 26, 1897.

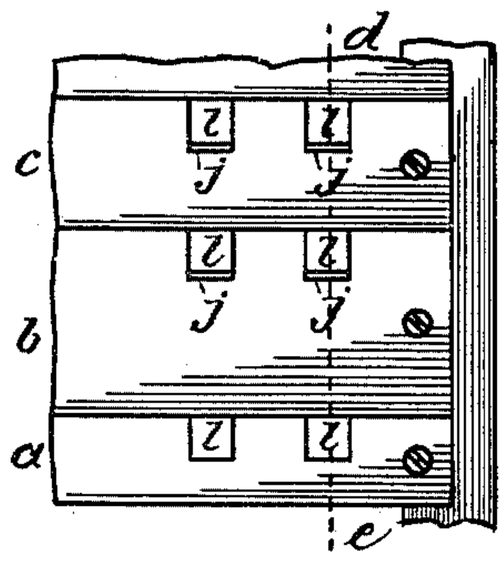

Fig. 1.a

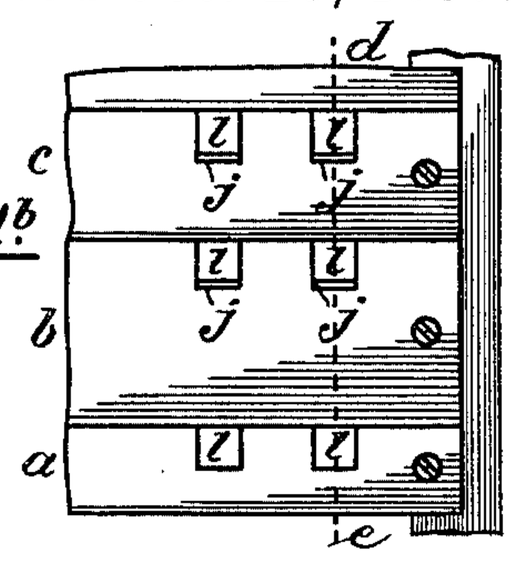

Fig. 1.b

Fig. 2.

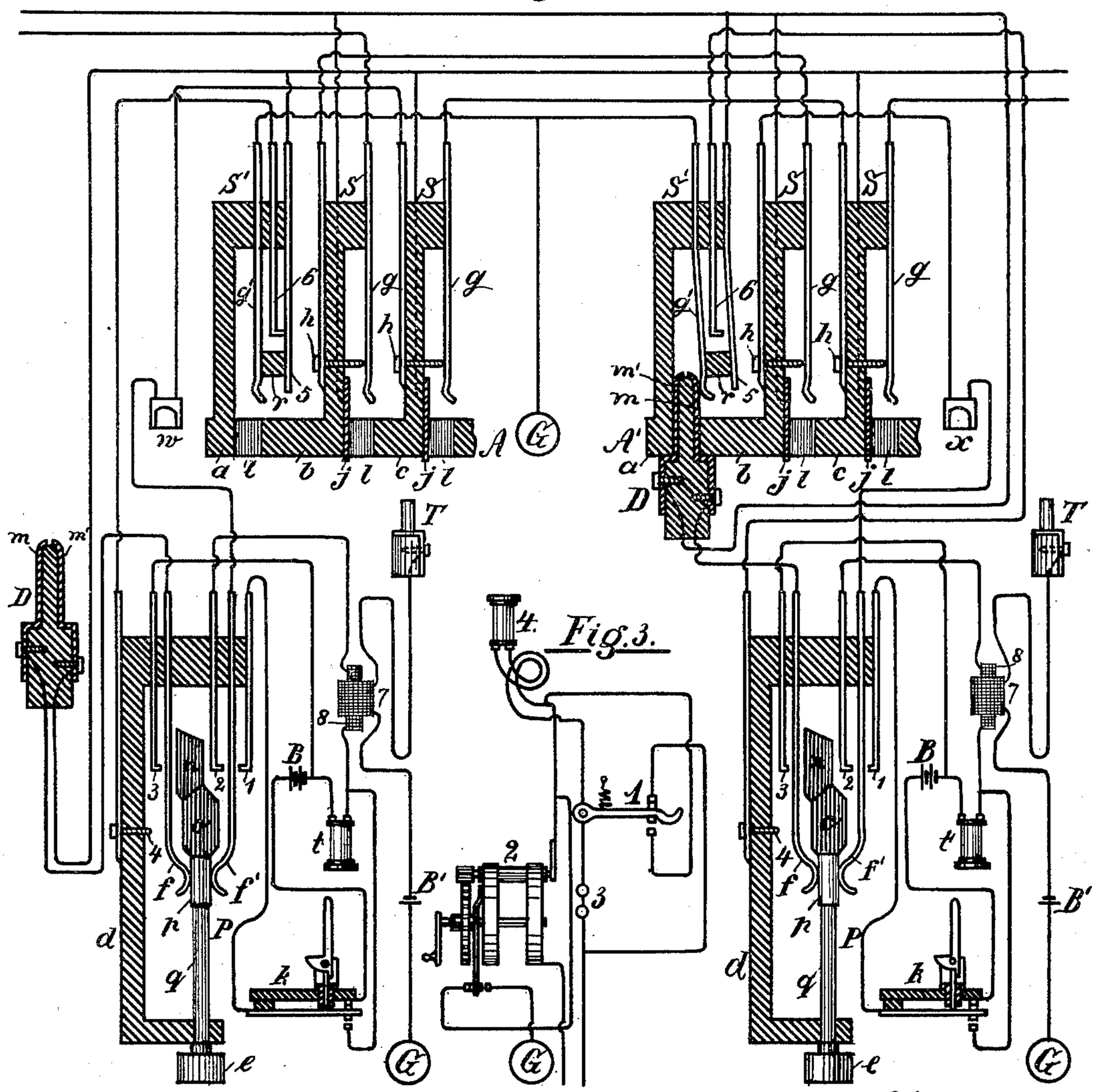

Fig. 3.

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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. 592,360, dated October 26, 1897.

Application filed January 10, 1890. Serial No. 336,597. (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 subscribers' lines are metallic-circuit lines and the two sides or branches of each line are connected at the central office with the two contact-pieces of a loop-switch plug adapted to be inserted into any line-switch at the board where the plug is located and, when inserted, to connect the two lines together for conversation. Each line has a double or loop plug, with a double cord attached, and switches and apparatus connected with the circuit, whereby an operator to whom the line is given to answer its calls may readily connect her telephone into the circuit for conversation, may readily connect her calling-generator into the circuit with a line wanted, may receive the clearing-out signals, and perform the other usual operations of an exchange system. The double plugs and cords of the exchange are distributed among the different boards of the exchange, and the special central-office apparatus which belongs to any line is conveniently located at the board where the cord and plug is located. Such a system is called a "single-cord" system.

My invention relates to a single-cord system for metallic-circuit lines.

It relates especially to the system described in my Patent No. 393,508, dated November 27, 1888, and to other single-cord systems for metallic-circuit lines in which each line is normally or when not switched connected with the ground at the central office and is disconnected from the ground when switched for use by a switch-plug being placed in one of its switches or when its switch-plug is removed from its normal position for use with the switch of another line.

The invention consists, first, in a system of switches, apparatus, and connections for each line by which the operator may expeditiously connect her telephone to the circuit of the line to find out what is wanted, may connect the lines together for conversation, and may connect her calling-generator or her telephone into the circuit.

It consists, secondly, of an improved testing organization for such lines.

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 shows the central-office-line apparatus and connections sufficient to illustrate my invention. Fig. 3 is a diagram of a subscriber's-station apparatus to be used in connection with the system.

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

G in each case represents a ground connection.

I place as many switchboards 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 similar switch for each line. Each switch has a contact-spring which normally connects with an insulated contact-piece. It has also a contact-piece insulated from the rest, except by the circuit connections. The switch is adapted to receive the loop-plugs, and when a plug is inserted it disconnects the spring from the contact-point and the two contact-pieces of the plug form connection with the spring and with said contact-piece, respectively.

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*. *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 of the switches. *l l* are the switch-holes, and *b c* are rubber strips on which the metal parts are mounted, substantially as shown, and through the fronts of which are the holes *l l*. These holes are adapted to receive the switch-plugs of the lines located at their board and marked D D, and when a plug is inserted into a switch it disconnects the spring *g* from the contact-point *h*, and the two contact-pieces of the plug form connection with the spring and with the piece *j*, re-

spectively. The insulated contact-pieces *j j* of the line-switches are placed along one of the faces of their respective switch-holes and extend to the front of the board, so that a test plug or device may be readily applied to them.

m m' are the two contact-pieces of a switch-plug D, and they are connected to the circuit of the line to which their plug belongs, substantially as shown and as will be described.

For each switch-plug is a switching device into which the plug is placed normally or when not in use for switching. This device has a contact-spring which is connected with the ground and with which the contact-piece *m* of the switch-plug is connected when the plug is inserted into the switching device. Each of said switching devices has also two insulated contact-pieces insulated from the spring and which are in contact when the plug is not in the device, but which are forced apart by the plug on its insertion. Two switching devices are shown in Fig. 2, one on each board, and each for the line whose plug and other operator's connecting apparatus is shown at the board where the device is located. These devices are marked S' S'. *g' g'* are their contact-springs, and 5 6 are their two contact-pieces, which are in contact when the plug is not in it and are separated while the plug is inserted.

r is a block, of rubber insulation, which connects the spring *g'* with the contact-piece 5, so that the two move together, and when a plug D is inserted and its contact *m* lifts the spring the contact-piece 5 is also moved out of contact with the piece 6.

The switch-plug located at board A' is shown inserted into its switching device, and the plug at A is shown not inserted into its device. The connections and contacts in each case are as above described for the respective devices. The plugs should be inserted in such a direction that their contact-pieces *m* form connection with the spring *g'* of their respective devices.

The spring-jack switches of the lines are marked *s s*.

w and *x* are line-annunciators, one for each line shown.

P P are operators' answering-switches, one for each line shown. There is such an answering-switch for each line, and it is located and conveniently mounted at the board where the line-annunciator, loop-plug, and switching device for the same are located.

d is a rubber frame which supports and insulates the various parts of the answering-switch.

f f' are two insulated contact-springs mounted in the frame *d* and shown arranged parallel with each other in such position as to move laterally when their ends are operated upon by a movable commutator-piece *n o p*, which works endwise between them.

1 and 2 are insulated contact-points carried by the frame *d* and arranged one on each side of the spring *f'*, so that when the spring is moved outwardly by the commutator-piece it makes contact with 1, and when it moves inwardly it makes contact with 2. 3 is a similar contact-point arranged on the outer side of contact-spring *f*, so that when the spring is moved outward it makes contact therewith.

4 is a contact-point mounted in the frame *d* and located on the outer side of contact-spring *f*, but near its end and at a greater distance from it than the contact-point 3, so that after the spring *f* has been moved into contact with 3 a further movement is required to bring it into contact with 4.

q is the sliding rod of the commutator-piece, which passes through the frame *d* and terminates at one end in a button *e*, which is placed in a convenient position for the operator to manipulate to draw the rod in and out in order to carry on the intended switching operations. *p* is a metal piece fastened to the other end of the rod *q* and moves in and out as the rod is moved. At the end of this metal piece *p* is fastened an irregularly-shaped rubber piece, the two ends of which are marked *n* and *o*, respectively. This piece also moves with the rod, being carried by the piece *p*.

The pieces *e q p* and the rubber piece *n o* move together as one piece as the operator manipulates the button *e*. They may be called the "commutator-piece" of the answering-switch. On each side of the commutator-piece the faces of the parts *n o p* constitute what I will call "commutator-surfaces," and they are in three different planes at different distances from the axis of the commutator-piece in its line of motion.

Obviously the spring *f'* need not bear on the part marked *n* of the commutator-piece, because the spring may be supported in position by the contact-piece 2. The inclined face of *o*, extending from *n* to the outer face of *o*, is the part of the commutator-piece that lifts the spring *f'* into its central position.

All the parts of the answering-switch are constructed, insulated, mounted, and adjusted substantially as shown and to perform the switching operations and connections which I shall now describe.

The button *e* and the metal piece *p* furnish shoulders or stops for the commutator-piece, which limit its inward and outward motions. When the commutator is pushed in, as shown in the drawings, until the outer stop is against or close to the standard of the frame, the two springs *f f'* rest on the metal piece *p*, which then electrically connects them, and are insulated from and unconnected with the contact points or pieces 1, 2, 3, and 4. When the commutator is pulled out to its central position, so that the springs *f f'* rest on the central part *o* of the rubber piece, the spring *f'* is in connection with the contact-piece 1 and the spring *f* is in connection with the contact-piece 3. When the commutator is pulled out still farther, so that the inner shoulder is

close to the standard of the frame, the spring f' is in connection with the contact-piece 2 and the spring f is in connection both with the contact-piece 3 and the contact-piece 4.

t is the operator's telephone. B is her calling-generator.

k is a three-point key the lever of which normally bears on the upper contact and when the key is depressed bears on the lower contact, while the connection with the upper contact is then broken.

7 is the primary of an induction-coil, and 8 is the secondary of the coil. Both coils should preferably have comparatively a large number of convolutions, and not merely the secondary coil, as is frequently the case in the construction of induction-coils.

B′ B′ are test-batteries.

T T are test plugs or devices each attached by a flexible cord to its test-circuit and adapted to be brought for testing into connection with any of the contact-pieces j j at its board.

There should be one key k, an operator's telephone, an induction-coil, and a test plug and cord for each operator. She also has a calling-generator B and a test-battery.

For each line of the exchange, as before stated, there is a double loop-plug, a switching device in which the plug is normally placed, an answering-switch, the spring-jack switches, one on each board, and the annunciator.

The connections of the line with its special apparatus and with the operator's apparatus mentioned above are as follows: One side or branch of the line passes successively through the pairs of contacts g h of the switches of the line on the several boards, passing in each case to the spring first. It then passes through the line-annunciator to spring f' and through the metal piece p of the commutator-piece and spring f to the contact-piece m of the loop-plug, which is the terminal of this side or branch of the line. The other side or branch of the line is connected with contact-piece m' of the plug and is also connected with the contact-pieces j j of the switches of the line and with the contact spring or piece 5 of the switch devices S′.

One side of the operator's calling-generator and one side of her telephone are connected to the contact-piece 3 of the answering-switch. The other side of the generator is connected to the upper contact-point of the key k, and the lever of the key is connected to contact-piece 1 of the answering-switch. The other side of the telephone is connected through the secondary of the induction-coil and then passes to contact-piece 2. A branch wire or circuit passes from the second-mentioned side of the line (the side connected with the plug contact-piece m') through the contact-points 5 and 6 of the switching device to contact-piece 4 of the answering-switch.

The lower contact-point of the key k is connected to that side of the operator's telephone to which the secondary of the induction-coil is connected.

The operator's test-plug, the test-battery, and the primary of her induction-coil are connected together in a circuit which is grounded, as shown.

The springs g' g' of the switching devices into which the switch-plugs are normally placed (with the contact-piece m of the plug in connection with the spring g') are connected with the office ground.

In the subscriber's-station apparatus shown in Fig. 4, 1 is the telephone-switch. 2 is the calling-generator. 3 is the signal-receiving bell, and 4 is the subscriber's telephone. These parts may be the usual forms of apparatus and may be connected as shown or in other ways, so as to produce the required result. The generator, however, is modified and is as shown. When it is not in operation, the subscriber's line is open to the ground at his station. While it is being operated the line is automatically grounded with the armature-coil between said ground connection and the normal ground connection of the line at the central office.

The operation of the system is as follows: When a line is not in use, its plug rests in its switching device, as described above, and the commutator of its answering-switch is pushed in and is substantially in the position in which it is shown in the drawings. There is a complete circuit of one branch of the line through its switch contact-points, the springs f f' bridged or connected by the metal piece p, and through one of the strands of the double cord to the contact-piece m, and thence to the ground through the spring g'. When a subscriber sends in a call on his generator, he temporarily grounds the line through the operation of the automatic device of the generator with the armature-coil between said ground connection and the normal office ground through spring g'. A calling-current passes over the line which operates the line-annunciator. The operator then removes the plug from its normal position in its switching device S′, thereby disconnecting the line from the ground, and pulls the commutator-piece of the answering-switch out, so that the springs f f' rest on piece n. The spring f' is then in contact with the piece 2 and the spring f is in contact with both 3 and 4. The two branches of the line are thereby closed to each other, with the operator's telephone in the circuit, and she receives the order of the subscriber. The circuit is as follows: from the line-annuciator to spring f', contact-piece 2, secondary 8 of induction-coil, through operator's telephone to contact-piece 3, contact-spring f and contact 4, thence through the contacts 6 5 of the switching device to the other side or branch of the line. The operator then tests the line wanted by placing her test-plug on the contact-piece j of its switch. If said line is not switched at any board, there will be a closed circuit established for the test-battery and the primary of the induction-coil from the ground of the test system to the test-plug and test contact-piece

j over the line and back to its switches *s*, thence through its answering-switch and switching device to ground by way of the plug-contact *m* and spring-contact *g'*. This circuit being closed, an induction-current will be generated in the circuit containing the operator's telephone and the secondary of her induction-coil and she will hear a click in her telephone and thereby know that the line is free to be connected to. She then places the plug of the calling-line in the switch of the line tested. She then pushes the commutator-piece in from its outer position to its inner position, (the one shown in the drawings.) While in this motion the springs *f f'* rest on the rubber section *o*, contact-point 4 is out of contact with the spring *f*, and the bridge connection between the branches of the calling-line is open, the springs *f'* and *f* are in contact with pieces 1 and 3, respectively, and the two lines are connected together in metallic circuit, with the calling-generator in their circuit, and the bell of the subscriber wanted is thereby rung. This circuit is as follows: from the annunciator of the calling-line to contact-spring *f'*, contact-piece 1, calling-key, and its upper contact to calling-generator B, thence to contact-piece 3, spring *f*, and contact-piece *m* of the plug of the calling-line, over the line of the subscriber wanted, back to contact-piece *m'* of said plug, and over the circuit of the calling subscriber back to his annunciator. When the commutator-piece passes out, so that the springs *f f'* rest on the metal piece *p*, the two lines are in a closed metallic circuit for conversation, and neither the operator's telephone nor her calling-generator is in the circuit. When the lines are thus connected for conversation, the annunciator of the line on which the call originated is in the circuit to receive a clearing-out call and will be operated when either line sends in a clearing-out signal. The annunciator of the other line being cut off at the switch of the line used where the plug is inserted is not in the circuit.

Should an operator desire to satisfy herself whether the subscribers are through conversation, she presses on the key *k*, and while so pressing draws the commutator-piece into its central position, when the springs rest on the rubber section *o*, and her telephone is thereby looped into the circuit. The circuit is as follows: from the annunciator of the calling-line through spring *f'*, contact-piece 1, lever of calling-key, and its bottom contact to one side of the telephone, from the other side of the telephone to contact-piece 3, spring *f*, and contact-piece *m* of the plug D.

When an operator disconnects a connection, she merely removes the plug from the switch and places it in its normal position. When an operator on testing a line finds it to test "busy," she notifies the calling subscriber of the fact and replaces the plug in its normal position.

From the description of the apparatus it will be seen that the lines are normally grounded at one place and that at the central office and that when a line is switched for use either by its plug being withdrawn from ito normal position or by a plug being placed in one of its switches the line is disconnected from the ground. On this depends the test system by which the test instrument sounds when a line is not switched and does not sound when the line is switched and the test is made.

It will be seen from the description of the operation of the commutator-piece and the contacts with their connections operated upon by the commutator-piece that when the commutator-piece is in one position the operator's telephone is connected with the line, that when it is moved to another position the telephone is disconnected from the line and the generator is connected with the line, and that when it is moved to another position both the telephone and generator are disconnected from the line. It will also be seen that the operation of moving the commutator-piece from the first to the last position is accomplished by one motion of the operator as he moves the commutator-piece in one direction or plane. Generally two motions at least of the commutator-piece are required to accomplish those results in telephone-exchange operation. The system of calling, therefore, practically saves one motion of the operator when she answers a call.

Other arrangements of circuits and contacts than those shown and described may be employed in which the operator may by one motion of the commutator-piece of the line disconnect the telephone from the line, then connect the generator to the line, and finally leave the line disconnected from either telephone or generator.

My invention in switches and connections is applicable to other systems of testing.

The invention in testing is also applicable to other systems and obviates the use of a special disconnecting-key to be pressed on testing.

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

1. An answering-switch for a telephone-line having two contact-springs, a movable commutator-piece adapted to be moved to occupy three positions, and three contact-points, said commutator-piece having parts on which said springs alternately rest, one of said parts being of metal and the other two of an insulation, said parts operating to change the connections between the springs and to electrically connect the springs through the metal part of the commutator, substantially as described.

2. An answering-switch for a telephone-line having two contact-springs, four contact-points and a commutator-piece having a metal part and two rubber or insulation parts, said springs resting alternately on each of said three parts as the commutator-piece is moved, said parts operating to change the connections

between the springs and contact-points, substantially as described.

3. In an answering-switch for a telephone-line, a contact-spring and two contact-points, one point on each side of said spring, and another contact-spring and a contact-point placed near the spring, in combination with a commutator-piece adapted to be moved between the springs and on which they press, said commutator-piece having on one side three commutator-surfaces in different planes on which said first-mentioned spring alternately presses and on another side two commutator-surfaces in different planes on which said second-mentioned spring alternately presses, substantially as set forth.

4. In an answering-switch for a telephone-line, a contact-spring and two contact-points, one contact-point on each side of said spring, in combination with a commutator-piece adapted to be moved and having three commutator-surfaces in different planes against which the spring alternately presses, the first surface being nearest the axis of said commutator-piece in its line of motion, the second surface being farthest from said axis of motion and the third surface being in a plane between the two other surfaces, substantially as set forth.

5. In an answering-switch for a telephone-line, a contact-spring and two contact-points, one point on each side of said spring, and another contact-spring and two contact-points, both on the same side of the spring, in combination with a commutator-piece adapted to be moved between the springs and on which they press, said commutator-piece having on one side three commutator-surfaces in different planes against which said first-mentioned spring alternately presses, the first surface being nearest the axis of said piece in its line of motion, the second surface being farthest from said axis and the third surface being a metal surface and in a plane between the two other surfaces, and having on another side three commutator-surfaces in different planes against which said second-mentioned spring alternately presses, the first surface being farthest from the axis of the commutator-piece in its line of motion, the second surface being nearest the axis and the third surface being nearest the axis and a metal surface connected with said other metal surface, substantially as set forth.

6. In an answering-switch for a telephone-line, a contact-spring and two contact-points, one point on each side of said spring, and another spring and two contact-points, both points on the same side of the spring, in combination with a commutator-piece adapted to be moved between the springs and on which they press, said commutator-piece having on one side three commutator-surfaces in different planes against which said first-mentioned spring alternately presses, the first surface being nearest the axis of said commutator-piece in its line of motion, the second surface being farthest from said axis and the third surface being in a plane between the two other surfaces, and having on another side three commutator-surfaces in different planes against which said second-mentioned spring alternately presses, the first surface being farthest from the axis of the commutator-piece in its line of motion, the second surface being nearer the axis and the third surface being nearest the axis, substantially as set forth.

7. An answering-switch for a telephone-line having two contact-springs, a movable commutator-piece adapted to be moved to occupy three positions, and three contact-points, said springs in one position of the commutator being out of contact with said contact-points but in connection with each other, in another position of the commutator being one in contact with one contact-point and the other in contact with another contact-point, and in another position of the commutator said first-mentioned spring being in contact with said first-mentioned point and the other spring out of contact with said second-mentioned point and in contact with the third point, in combination with an operator's telephone and generator, one of said springs being connected to one side and the other spring to the other side of a telephone-circuit, one side of the telephone and one side of the generator being connected to said first-mentioned point, the other side of the generator being connected to said second-mentioned point, and the other side of the telephone connected to said third-mentioned point, substantially as set forth.

8. An answering-switch for a telephone-line having two contact-springs, a movable commutator-piece adapted to be moved to occupy three positions, and three contact-points, said springs in one position of the commutator being out of contact with said contact-points but in connection with each other, in another position of the commutator being one in contact with one contact-point and the other in contact with another contact-point, and in another position of the commutator said first-mentioned spring being in contact with said first-mentioned point and the other spring out of contact with said second-mentioned point and in contact with the third point, in combination with an operator's telephone and generator, one of said springs being connected to one side, and the other spring to the other side of a telephone-circuit, one side of the telephone and one side of the generator being connected to said first-mentioned point, the other side of the generator being connected to said second-mentioned point, and the other side of the telephone connected to said third-mentioned point, substantially as set forth.

9. An answering-switch for a telephone-line having two contact-springs, a movable commutator-piece adapted to be moved to occupy three positions, and three contact-points,

said commutator-piece having three parts which act on said springs alternately, and when the commutator-piece is in one position said springs are not in contact with said contact-points but in connection with each other, when the commutator-piece is in another position one of said springs is pressed into contact with one contact-point and the other into contact with another contact-point, and when the commutator-piece is in another position said first-mentioned spring remains in contact with said first-mentioned point and the other spring (passing from contact with said second-mentioned point) is in contact with the third point, in combination with an operator's telephone and generator, one of said springs being connected to the line and the other spring to the individual switching cord and plug of the line, one side of the telephone and one side of the generator being connected to said first-mentioned point, the other side of the generator being connected to said second-mentioned point, and the other side of the telephone connected to said third-mentioned point, substantially as set forth.

10. In a telephone-exchange system, a metallic-circuit line, the contact-points 5, 6, in the switching device in which the plug of the line is normally placed, which are in contact when the plug is removed from the switching device and only then in contact, in combination with the contact-spring *f* and point 4 in the answering-switch of the line, and the commutator-piece of the answering-switch operating when in one of its positions to force the spring into contact with the point 4, said contact-spring being connected to one side or branch of the line and the other side or branch of the line being connected through said pair of contact-points 5, 6, to said point 4, substantially as set forth.

11. In a telephone-exchange system, a metallic-circuit line, a bridge circuit or connection across the two sides or branches of the line normally or while the plug is in the plug-socket or switching device open at three places, a pair of contacts which automatically closes said circuit at one of said places when the switch-plug of the line is taken from its normal position, a commutator-piece, and pairs of contacts operated thereby which close said circuit at the two other places when said commutator-piece of the answering-switch of the line is moved from its normal position, substantially as set forth.

12. In a telephone-exchange system, a metallic-circuit line, a bridge circuit or connection across the two sides or branches of the line, normally or while the plug is in the plug-socket or switching device open at three places, a pair of contacts which automatically closes said circuit at one of said places when the switch-plug of the line is withdrawn from its normal position, a commutator-piece and pairs of contacts which close said circuit at the two other places when said commutator-piece of the answering-switch of the line is moved from its normal position and an operator's telephone in said bridge-circuit, substantially as set forth.

13. In a telephone-exchange system, a metallic-circuit line, a bridge circuit or connection across the two sides or branches of the line, normally or while the plug is in the plug-socket or switching device open at three places, a pair of contacts which automatically closes said circuit at one of said places when the switch-plug of the line is withdrawn from its normal position, pairs of contacts which close said circuit at the two other places when the commutator-piece of the answering-switch is moved from its normal position and an operator's telephone in said bridge-circuit between the two pairs of contacts last mentioned, substantially as set forth.

14. In a telephone-exchange system, a metallic-circuit line, an individual loop-switch plug for the line, a switching device into which the plug is normally placed, a bridge circuit or connection between the two sides or branches of the line, and a pair of contacts in said switching device, connected into said bridge circuit or connection, normally open to each other but automatically closed by the withdrawal of the plug, in combination with a calling-generator, and a commutator-piece operating on contacts, and movable in one plane or direction to three positions, in one of which the operator's telephone is in said bridge-circuit, in another of which the telephone is switched from said bridge-circuit and the generator is connected to the line and in the other of which neither the telephone nor the generator is connected to the line, substantially as set forth.

15. In a telephone-exchange system, telephone-lines and switch-plugs, one for each line each plug being adapted to be placed in a switch of either of the other lines and thereby connect its line with the other line, in combination with a contact-spring for each line connected to a line-contact of its plug, two contacts for each line, one in connection with an operator's telephone and the other in connection with a calling-generator and a commutator-piece adapted to be moved in one plane or direction to occupy three positions, and having three commutator-surfaces in different planes operating on said spring in different positions, in one of which said first-mentioned point is in connection with said spring, in another of which said first-mentioned point is out of connection and said second-mentioned point is in connection with said spring, and in another position of which both points are out of connection with said spring.

In witness whereof I hereunto subscribe my name this 20th day of December, 1889.

MILO G. KELLOGG.

Witnesses:
EMIL ABENHEIM,
MARGARETHA RIEHL.