

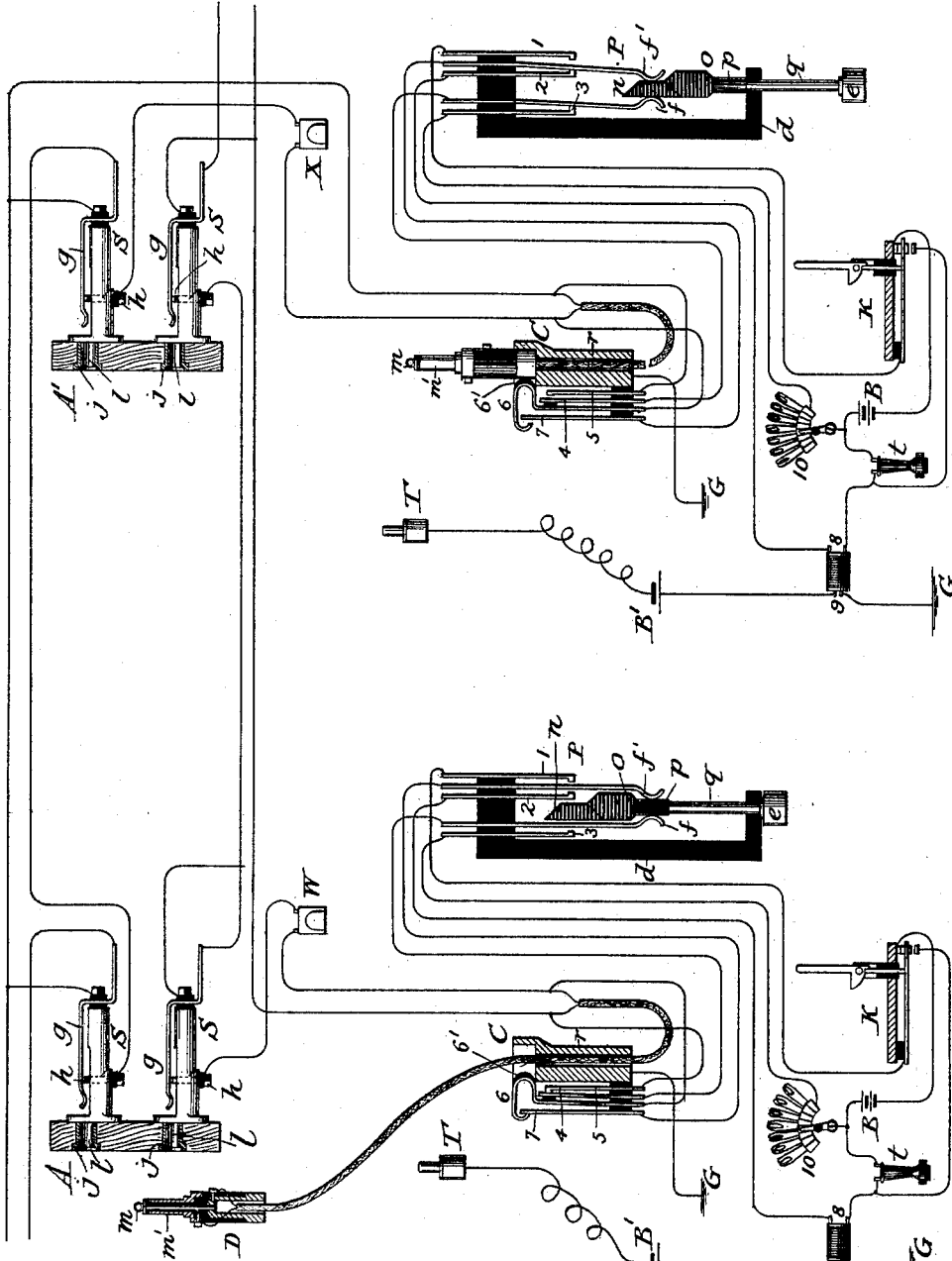
(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,361.

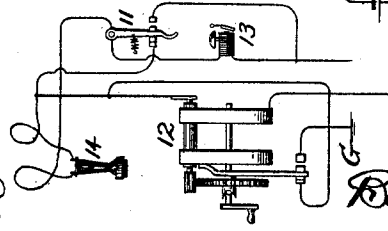
Patented Oct. 26, 1897.

Fig. 1.



Attest.
Simon P. Hollingworth
Baltus D. Long.

Fig. 2.



Inventor.
MILO G. KELLOGG
by his attorneys
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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. 592,361, dated October 26, 1897.

Application filed January 10, 1890. Serial No. 336,598. (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 call 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 are located. Such a system is called a "single-cord" system.

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

The invention consists 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.

Figure 1 shows the central-office line apparatus and connections sufficient to illustrate my invention. Fig. 2 is a diagram of a sub-

scriber'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. 1, A and A' represent sections of two multiple switchboards to which the same lines are connected. *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. 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*, respectively. *j j* are placed so that a test plug or device may be readily applied to them.

m m' are the two contact-pieces of a switch-plug, 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-piece which is connected with the ground and with which one of the contact-pieces of the switch-plug is connected when the plug is inserted into the switching device. In these plug switching devices (marked C C) *r* is a metal contact-piece con-

connected to the ground, with which the contact-piece *m* of the plug is in contact when the plug is in the device.

4, 5, 6, and 7 are contact-pieces, which are insulated from *r*, and are insulated from each other when the plug is in the device. These contact-pieces are mounted parallel to each other on the metal piece *r*, 5 being nearest piece *r*, 4 being next to 5, 6 next to 4, and 7 farthest from piece *r*. Pieces 4 and 6 are spring-contacts connected near their top by a rubber insulation-piece. Piece 6 is an irregularly-shaped spring, which bears on the plug when the plug is inserted, but is insulated from the contact-piece of the plug, and is moved by the plug by an insulation-piece 6', which is placed on the surface against which the plug-handle bears, and has a projection which extends beyond piece 7, opposite the side thereof and in close proximity thereto, so as to come in contact with it when released from the pressure of the plug on its insertion, so as to make the switch connections I shall now describe. When the plug is in the device, this piece 7 is pressed or wedged by the plug into such a position that all the contact-pieces are disconnected. When the plug is withdrawn, the spring is released from the pressure of the plug and moves until it comes in contact with piece 7, and it carries or forces piece 4 into contact with piece 5.

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 operator's 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. *ff'* are two contact-springs. 1, 2, and 3 are contact-points located and insulated substantially as shown, and which form connections with said springs *ff'*, as will hereinafter be described. The two springs are mounted parallel to each other and so that spring *f'* is between point 1 and spring *f* and close to point 1, and spring *f* is between point 3 and spring *f'* and close to point 3, while point 2 is between the two springs and close to spring *f'*.

q is a sliding rod which passes through the frame *d*. It terminates at one end in a button *e*, which is placed in a convenient position for the operator to move the rod in and out in order to carry on the intended switching operations.

p is a rubber piece carried on the other end of the rod. At the end of this rubber piece *p* is fastened an irregularly-shaped rubber piece, the two portions of which are marked *n* and *o*, respectively. This piece also moves with the rod between the two springs, being carried by the piece *p*.

The pieces *l 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. The button *e* and the piece *p* furnish shoulders or stops for the commutator-piece, which limit its inward and outward motions. When the commutator is pushed in until the outer stop is against or close to the standard of the frame, the two springs *ff'* rest on the piece *p* and are insulated from and unconnected with the contact points or pieces 1, 2, and 3. When the commutator is pulled out to its central position, so that the springs *ff'* 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 with the contact-piece 3.

Fig. 2 shows the commutator-piece in the outer and inner positions.

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.

10 is the resistance-coil.

9 is the primary of the induction-coil, and 8 is the secondary of the coil. Both coils of the induction-coil 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 *jj* 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 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 contact-piece *m* of the loop-plug. The other side or branch of the line is connected with contact-piece *m'* of the plug and is also con-

nected with the contact-pieces $j j$ of the switches of the line.

One side of the operator's calling-generator B and one side of her telephone t are connected to the contact-piece 3, and in the circuit-wire which connects the telephone and generator with piece 3 is placed the resistance-coil 10. 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. 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 one side of the line—say to the side connected with the contact-pieces $j j$ —through the contact-points 5 and 4 of the plug switching device to one of the contact-springs—say f —of the answering-switch. Another branch wire passes from the other side or branch of the line through the other contact-points 6 and 7 of the plug switching device to the other contact-spring f' 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 8 of the induction-coil is connected.

The operator's test-plug T, the test-battery B', and the primary 9 of her induction-coil are connected together in a circuit which is grounded, as shown.

In the subscriber's-station apparatus shown in Fig. 2, 11 is the telephone-switch. 12 is the calling-generator. 13 is the signal-receiving bell, and 14 is the subscriber's telephone. One side of the subscriber's circuit passes through the call-bell 13 to the switch 11 and thence to one side of the telephone. The other side of the circuit is connected with the opposite side of the telephone, with the calling-generator 12 between the telephone and line. This side of the circuit is connected from a point between the generator and telephone with the bottom contact of the telephone-switch, so that the telephone is shunted when on its switch. The first-mentioned side of the line is connected from a point outside the call-bell with the top contact of the switch, so that the bell is shunted when the telephone is off its switch. 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, as shown, according to a well-known form. When it is not in operation, its armature is shunted through the frame of the generator and 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 pulled

out and is substantially in the position in which it is shown in the drawings at board A'. There is a complete circuit of one branch of the line through its switch contact-points and the annunciator, and thence through one of the strands of the double cord to the contact-piece m , and thence to the ground through the switching device. 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. A calling-current passes over the line which operates the line-annunciator. The operator then removes the plug from its normal position. When she has done this, the office ground of the line is removed and the pair of contact-points 4 5 and the pair of contact-points 6 7 of the plug switching device are both closed. The two branches of the line are thereby placed on closed circuit with the operator's telephone in the circuit, and the operator finds out by conversation what line is wanted. The circuit is from one branch of the line to contact 5, and thence through contact 4 and the circuit connection to spring f of the answering-switch, thence through contact 3 and the circuit connection through the operator's telephone to contact 2, thence through spring f' and the circuit connection to contact 7, and thence through contact 6 and the circuit connection to the other side of the line. She then tests the line wanted, (by placing her test-plug on the contact-piece j of the line,) and if she finds the line is not switched she places the loop-plug of the line on which the call came into the switch of the line wanted. By so doing she disconnects the contacts $g h$ of the switch and connects the two sides of the line with the contact-pieces $m m'$ of the plug, and this line also is disconnected from the office ground by the opening of the contacts $g h$. She then pushes in the commutator-piece of the answering-switch until it occupies its inner position. (Shown at board A.) While the commutator-piece is passing over its central position where the spring f' rests on the piece O the operator's generator is connected into the branch or bridge circuit which connects the two sides of the line to which the answering-switch belongs, and a calling-current passes through the circuit of both lines, the generator-current dividing or splitting into the two circuits. The circuit is from one branch of the line to contact 5, and thence through contact 4 and the circuit connection to spring f of the answering-switch, thence through contact 3 and the circuit connection through the calling-generator to contact 1, thence through spring f' and the circuit connection to contact 7, and thence through contact 6 and the circuit connection to the other side of the line. When the commutator-piece has reached the inner position, so that the springs $f f'$ rest on the rubber piece p , the springs are out of contact with

the contact-points 1, 2, and 3, and the branch or bridge circuit is open at both points. The operator's telephone and generator are then entirely disconnected from the circuit of the lines, and they are connected into an uninterrupted metallic circuit with the annunciator of the line in which the call originated in the circuit to receive a clearing-out signal.

When an operator desires to listen to determine whether the subscribers are through conversation, she presses down the lever of the key *k*, and while it is in that position draws the commutator-piece of the answering-switch out, so that it occupies the central position, with the springs *ff'* resting on the part *o*. The branch or bridge circuit is then closed by the connections between *f* and 3 and between *f'* and 2 and the circuit connections, as heretofore traced, and the operator's telephone is in the bridge-circuit and she will hear the conversation without interrupting it. I prefer to have a resistance-coil equal to at least the resistance of any line of the exchange placed in circuit with the telephone in the branch or bridge circuit, so as not to shunt an undue amount of the telephone-current into the bridge-circuit which contains the telephone when she connects her telephone to the circuit, as described. This resistance-coil is marked 10. It is placed in the circuit-wire which connects the contact-point 3 with the operator's telephone and generator.

When the operator desires to clear out a connection, she takes the loop-plug from the switch and places it in its switching device. By so doing the lines are disconnected from each other, their normal ground connections are again established, and the pairs of contact-points 4 5 and 6 7 are again opened. The operator then places the answering-switch in its normal position, where the contact-springs *ff'* rest on the rubber piece *n*, and the apparatus is in position to receive a new call on the line. When a new call is received on the annunciator, she connects her telephone to the circuit by the mere act of withdrawing the plug from its switching device, as heretofore described.

When an operator tests a line, as heretofore mentioned, and the line is not switched, a complete circuit is established from the ground connection of the test-battery to the normal ground connection of the line, and a battery-current passes over the circuit. This circuit is from the ground through the primary 9 of the induction-coil and the test-battery *B'* to contact-piece *j* of the switch, thence through the circuit of the line by way of the subscriber's station, thence through the pairs of contacts *gh* of the line-switches, and thence through the connection between piece *m* of the switch-plug and the metal piece *r* of the switching device to the ground. This operates through the operator's induction-coil to send an induction-current through the operator's telephone (which is then on closed cir-

cuit with the line in which the call originated) and she will hear a click in the telephone and know that the line is free to be switched to. If, however, the line tested is switched at any board, it is disconnected from the ground and there will be no current established and therefore no click in the telephone. If the line is switched by the insertion of a plug into one of the line-switches, the line is disconnected from the ground by the opening of the contacts *gh* of the switch. If it is switched by the use of its switch-plug, it is disconnected from the ground by the opening of the contact between piece *m* of the plug and piece *r*, in which the plug is normally placed.

Each operator's special apparatus, which includes her telephone, key, resistance-coil, induction-coil, test-plug, calling-generator, and battery, are connected to the answering-switch of each line assigned to her to answer, substantially as shown and described for the lines shown in the drawings.

I prefer to have the key *k* actuated by a cam-lever, as shown in the drawings, or to have some other mechanism by which the contact-spring of the key may be placed in one or the other of the two positions and left there without the continued manipulation of the operator. By this means an operator may place the key in position where her telephone is connected to the lever, leave it there, and be free to operate one after another of her answering-switches, so as to listen to determine whether the subscribers connected together are through conversation.

By the organization as described the operator is enabled to answer a subscriber, make his connection with another line, and call on the line with a minimum of operations and work. These operations are merely to take his plug from its normal position, place her test-plug on the test-piece of the line wanted, place the plug in the switch of the line wanted, and push the commutator-piece into its inner position.

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

1. In a telephone-exchange system, a metallic-circuit line, the two sides or branches of which are normally open to each other at the central office; a switch-plug for the line, a switching device for the plug into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the switching device and out of contact while the plug is inserted in the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points by which the operator may at will loop her telephone into the circuit of said bridge-wire between said pairs of

contact-points of the switching device or disconnect her telephone from the bridge-wire and leave said wire open at the answering-switch, substantially as set forth.

2. In a telephone-exchange system, a metallic-circuit line, a switch-plug for the line, a switching device for the line into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-pieces of each pair being in contact while the plug is out of the switching device and out of contact while the plug is inserted into the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points by which the operator may at will either loop her telephone into the circuit of said bridge-wire between said pairs of contact-points of the switching device or may loop her generator into said bridge-wire between said pairs of points, or may leave the bridge-wire open at the answering-switch with neither her telephone nor generator connected to it, substantially as set forth.

3. In a telephone-exchange system, a metallic-circuit line, a switch-plug for the line, a switching device for the plug in which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the device and out of contact while the plug is in the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points and connections and a commutator-piece adapted to be placed in three positions successively at the will of the operator, in the first position of which her telephone is looped into the circuit of said bridge-wire between said pairs of contact-points of the switching device, in the next position of which the calling-generator is looped into the circuit of the bridge-wire between said pairs of points and in the last position of which said bridge-wire is left open at the answering-switch with neither the telephone nor the generator connected to it, substantially as set forth.

4. In a telephone-exchange system, a metallic-circuit line, a switch-plug for the line, a switching device for the plug into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the device and out of contact while the plug is in the device, in combination with a bridge or connecting

wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, an answering-switch for the line with contact-points and connections and a commutator-piece adapted to be placed in three positions successively, at the will of the operator, in the first position of which her telephone is looped into the circuit of said bridge-wire between said pairs of contact-points of the switching device, in the next position of which the calling-generator is normally looped into the circuit of the bridge-wire between said pairs of points and in the last position of which said bridge-wire is left open at the answering-switch with neither the telephone nor the generator connected to it, and a key or switch with contact-points by which when the commutator is in said second position the circuit through the generator may be broken, substantially as set forth.

5. In a telephone-exchange system, a metallic-circuit line, a switch-plug for the line, a switching device for the plug into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the device and out of contact while the plug is in the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, an answering-switch for the line with contact-points and connections and a commutator-piece adapted to be placed in three positions successively, at the will of the operator, in the first position of which her telephone is looped into the circuit of said bridge-wire between said pairs of contact-points of the switching device, in the next position of which the calling-generator is normally looped into the circuit of the bridge-wire between said pairs of points and in the last position of which said bridge-wire is left open at the answering-switch with neither the telephone nor the generator connected to it, and a key or switch with contact-points by which when the commutator is in said second position the circuit through the generator may be broken and the circuit established through the telephone, substantially as set forth.

6. In a telephone-exchange system, a metallic-circuit line, the two sides or branches of which are normally open to each other at the central office, a loop-switch plug for the line in the two contact-pieces of which terminate the two sides or branches of the line, said plug being adapted to be inserted into the switch of any other metallic-circuit line at its board and when inserted to connect the contact-pieces of the switch with the two sides or branches of the line, a switching device for the plug into which the plug is normally in-

serted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the switching device and out of contact while the plug is inserted in the device, in combination with a bridge or connecting wire for said line, the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points by which the operator may at will loop her telephone into the circuit of said bridge-wire between said pairs of contact-points of the switching device or disconnect her telephone from the bridge-wire and leave said wire open at the answering-switch, substantially as set forth.

7. In a telephone-exchange system, a metallic-circuit line, a loop-switch plug for the line in the two contact-pieces of which terminate the two sides or branches of the line, said plug being adapted to be inserted into the switch of any other metallic-circuit line at its board and when inserted to connect the contact-pieces of the switch with the two sides or branches of the line, a switching device for the line into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-pieces of each pair being in contact while the plug is out of the switching device and out of contact while the plug is inserted into the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering switch for the line with contact-points by which the operator may at will either loop her telephone into the circuit of said bridge-wire between said pairs of contact-points of the switching device or may loop her generator into said bridge-wire between said pairs of points, or may leave the bridge-wire open at the answering-switch with neither her telephone or generator connected to it, substantially as set forth.

8. In a telephone-exchange system, a metallic-circuit line, a loop-switch plug for the line in the two contact-pieces of which terminate the two sides or branches of the line, said plug being adapted to be inserted into the switch of any other metallic-circuit line at its board and when inserted to connect the contact-pieces of the switch with the two sides or branches of the line, a switching device for the plug into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the device and out of contact while the plug is in the device, in combination with a bridge or connecting wire

for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points and connections and a commutator-piece adapted to be placed in three positions successively at the will of the operator, in the first position of which her telephone is looped into the circuit of said bridge-wire between said pairs of contact-points of the switching device, in the next position of which the calling-generator is looped into the circuit of the bridge-wire between said pairs of points and in the last position of which said bridge-wire is left open at the answering-switch with neither the telephone nor the generator connected to it, substantially as set forth.

9. In a telephone-exchange system, a metallic-circuit line, a loop-switch plug for the line in the two contact-pieces of which terminate the two sides or branches of the line, said plug being adapted to be inserted into the switch of any other metallic-circuit line at its board and when inserted to connect the contact-pieces of the switch with the two sides or branches of the line, a switching device for the plug into which the plug is normally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the device and out of contact while the plug is in the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, an answering-switch for the line with contact-points and connections and a commutator-piece adapted to be placed in three positions successively, at the will of the operator, in the first position of which her telephone is looped into the circuit of said bridge-wire between said pairs of contact-points of the switching device, in the next position of which the calling-generator is normally looped into the circuit of the bridge-wire between said pairs of points and in the last position of which said bridge-wire is left open at the answering-switch with neither the telephone nor the generator connected to it, and a key or switch with contact-points by which when the commutator is in said second position the circuit through the generator may be broken, substantially as set forth.

10. In a telephone-exchange system, a metallic-circuit line, a loop-switch plug for the line in the two contact-pieces of which terminate the two sides or branches of the line, said plug being adapted to be inserted into the switch of any other metallic-circuit line at its board and when inserted to connect the contact-pieces of the switch with the two sides or branches of the line, a switching device for the plug into which the plug is nor-

5 mally inserted, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the device and out of contact while the plug is in the device; in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, an answering-switch for the line with contact-points and connections and a commutator-piece adapted to be placed in three positions successively, at the will of the operator, in the first position of which her telephone is looped into the circuit of said bridge-wire between said pairs of contact-points of the switching device, in the next position of which the calling-generator is normally looped into the circuit of the bridge-wire between said pairs of points and in the last position of which said bridge-wire is left open at the answering-switch with neither the telephone nor the generator connected to it and a key or switch with contact-points by which when the commutator is in said second position the circuit through the generator may be broken and the circuit established through the telephone, substantially as set forth.

11. In a telephone-exchange system, a plug switching device for a metallic-circuit line, adapted to receive a loop-switch plug for the line when the plug is not in use, the two contact-pieces of the plug being connected through flexible conductors to the two sides or branches of the line, respectively, said plug switching device having two pairs of contact-points which are open while the plug is in the device but automatically closed on the withdrawal of the plug, two contact-points, one of each pair, being connected to the two sides of the line, respectively, two of said contacts, one of each pair being springs moved by the plug on its insertion to open the two pairs of points and the two other points being immovable or stationary on the withdrawal or insertion of the plug, in combination with an answering-switch for said line, having two pairs of contact-points normally in contact but opened at the will of the operator, two of such contact-points, one of each pair being connected to the two other contact-points, respectively, of the plug switching device, and the two other contact-points of the operator's switching device being connected to the two sides, respectively, of the operator's telephone, substantially as set forth.

12. In a telephone-exchange system, a plug switching device for a metallic-circuit line, adapted to receive a loop-switch plug for the line when the plug is not in use for switching, the two contact-pieces of the plug being connected, through flexible conductors, to the two sides or branches, respectively, of the line, said plug switching device having two pairs of contact-points which are open when the

plug is in the device but are automatically closed on the withdrawal of the plug, two contact-points, one of each pair, being connected to the two sides or branches of the line, in combination with an answering-switch for said line, having two pairs of contact-points, two contact-points of which are connected to the two other contact-points of the plug switching device, one of the other points being connected to one side of the operator's telephone and also to one side of her calling-generator and the other point connected to the other side of the telephone, and a fifth point normally out of contact with the other points and connected to the other side of the generator, and a commutator-piece adapted at the will of the operator to be placed in three positions, when in its normal position the two pairs of contact-points of the answering-switch being in contact, when in its next position the pair to which are connected one side of the telephone and generator remaining in contact and the other pair being separated and that one which is connected with the line brought into contact with said fifth point, and when in the third position all the contact-points of the answering-switch being out of contact, substantially as set forth.

13. In a telephone-exchange system, a metallic-circuit line, a loop-switch plug for the line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, a plug switching device into which the plug is placed when not in use, having pairs of contacts therein and connections by which the operator's telephone is bridged across the two sides of the line when the plug is withdrawn from said device, in combination with an answering-switch having pairs of contacts and a commutator-piece therein, and connections by which the operator may at will disconnect said bridge connection through the telephone and connect her calling-generator in a bridge across the two sides of the line and may disconnect both telephone and generator from the line, substantially as set forth.

14. 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 only in different planes on which said second-mentioned spring alternately presses, substantially as set forth.

15. 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 be-

tween 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 in a plane between the two other surfaces, and having on another side two commutator-surfaces against which said second-mentioned spring alternately presses, the first commutator-surface being farther than the other from the axis of the commutator-piece in its line of motion, substantially as set forth.

16. In a telephone-exchange system, a metallic-circuit line, the two sides or branches of which are normally open to each other at the central office, a switch-plug for the line, a switching device for the plug into which the plug is normally inserted, a pair of contacts, one connected with the line and the other with the ground, normally closed but open on the withdrawal of the plug from the switching device, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections) the two contact-points of each pair being in contact while the plug is out of the switching device and out of contact while the plug is inserted in the device, in combination with a bridge or connecting wire for said line the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points by which the operator may at will loop her telephone into the circuit of said bridge-wire between said pairs of contact-points of the switching device or disconnect her telephone from the bridge-wire and leave said wire open at the answering-switch, substantially as set forth.

17. In a telephone-exchange system, a metallic-circuit line, the two sides or branches of which are normally open to each other at the central office, a loop-switch plug for the line in the two contact-pieces of which terminate the two sides or branches of the line, said plug being adapted to be inserted into the switch of the other metallic-circuit line at its board and when inserted to connect the contact-pieces of the switch with the two sides or branches of the line, a switching device for the plug into which the plug is normally inserted, a pair of contacts, one connected with the line and the other with the ground, normally closed but open on the withdrawal of the plug from the switching device, two pairs of contact-points in said switching device insulated from each other (except by the circuit connections), the two contact-points of each pair being in contact while the plug is out of the switching device and out of contact while the plug is inserted in the device, in combination with a bridge or

connecting wire for said line, the two ends of which are connected to the two sides or branches of the line respectively and in which are said two pairs of contact-points, and an answering-switch for the line with contact-points by which the operator may at will loop her telephone into the circuit of said bridge-wire between said pairs of contact-points of the switching device or disconnect her telephone from the bridge-wire and leave said wire open at the answering-switch, substantially as set forth.

18. In a telephone-exchange system, a plug switching device for a metallic-circuit line, adapted to receive a loop-switch plug for the line when the plug is not in use, the two contact-pieces of the plug being connected through flexible conductors to the two sides or branches of the line, respectively, said plug switching device containing a grounded contact-piece with which a contact-piece of the plug connected with the line is normally in contact and also containing two pairs of contact-points which are open while the plug is in the device but automatically closed on the withdrawal of the plug, two contact-points, one of each pair being connected to the two sides of the line, in combination with an operator's switching device for said line, having two pairs of contact-points normally in contact but opened at the will of the operator, two of such contact-points, one of each pair, being connected to the two other contact-points, respectively, of the plug switching device, and the two other contact-points of the operator's switching device being connected to the two sides, respectively, of the operator's telephone, substantially as set forth.

19. In a telephone-exchange system, a metallic-circuit line, a loop-switch plug for the line to the two contact-pieces of which, respectively, are connected the two sides or branches of the line, a plug switching device into which the plug is placed normally or when not in use and a bridge circuit or connection for said line containing the operator's telephone said circuit being normally open but automatically closed by the plug switching device on the withdrawal of the plug from its normal position, in combination with a calling-generator and a commutator-piece moved in one direction at the will of the operator to occupy three positions, in one of which her telephone is in said bridge circuit or connection, in another of which the generator is connected with and the telephone disconnected from the line and in another of which neither the telephone nor the generator is connected with the line.

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

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,
MARGARETHA RIEHL.