(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,341. Patented Oct. 26, 1897.

Fig. 1.a

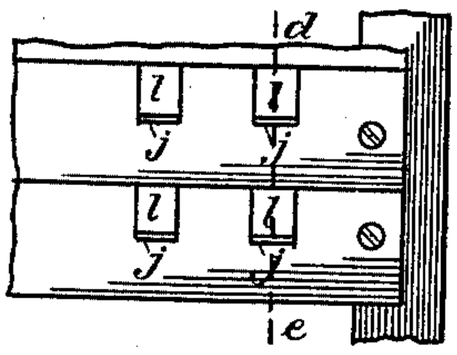


Fig. 1.b

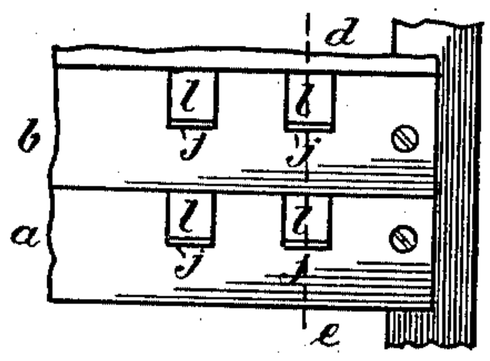


Fig. 2.

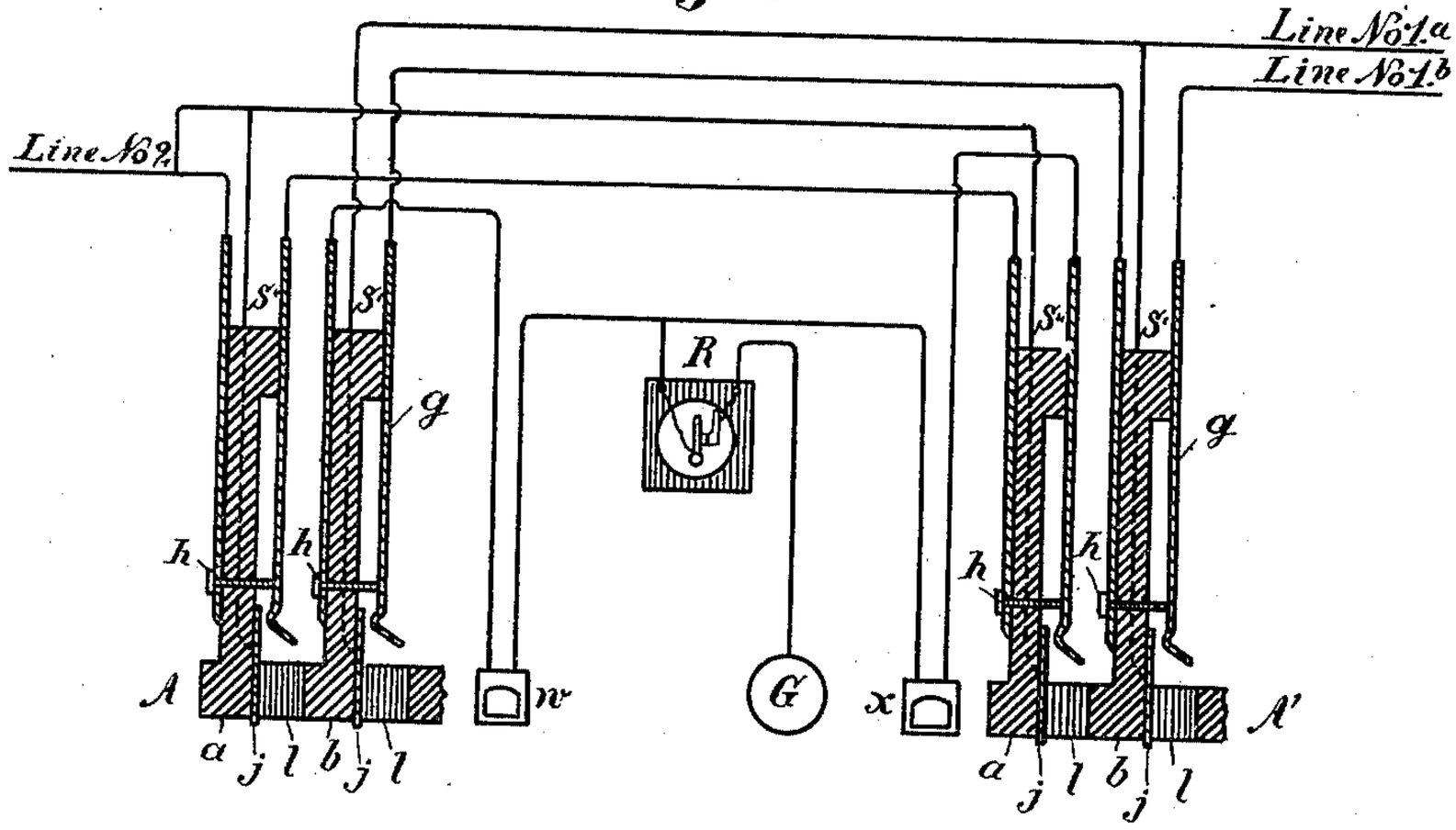


Fig. 3.

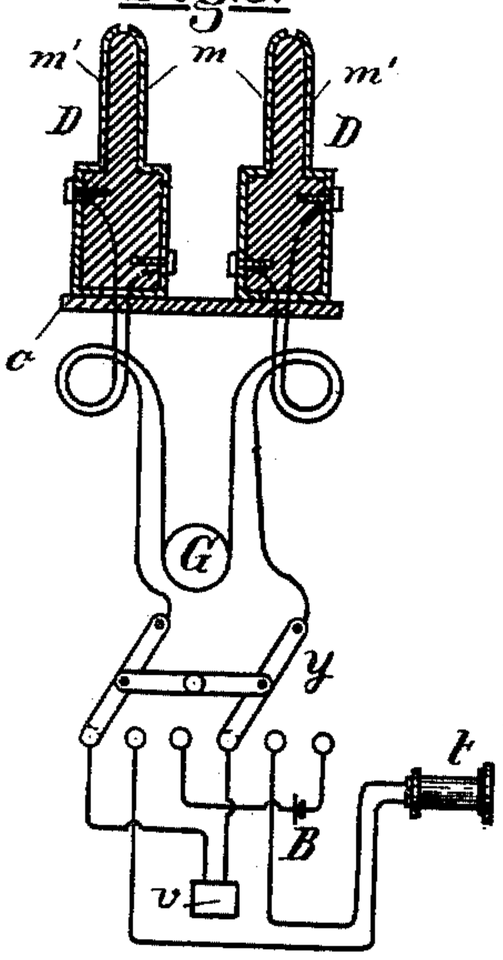


Fig. 5.

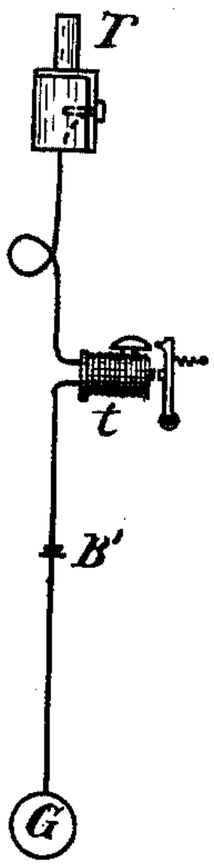
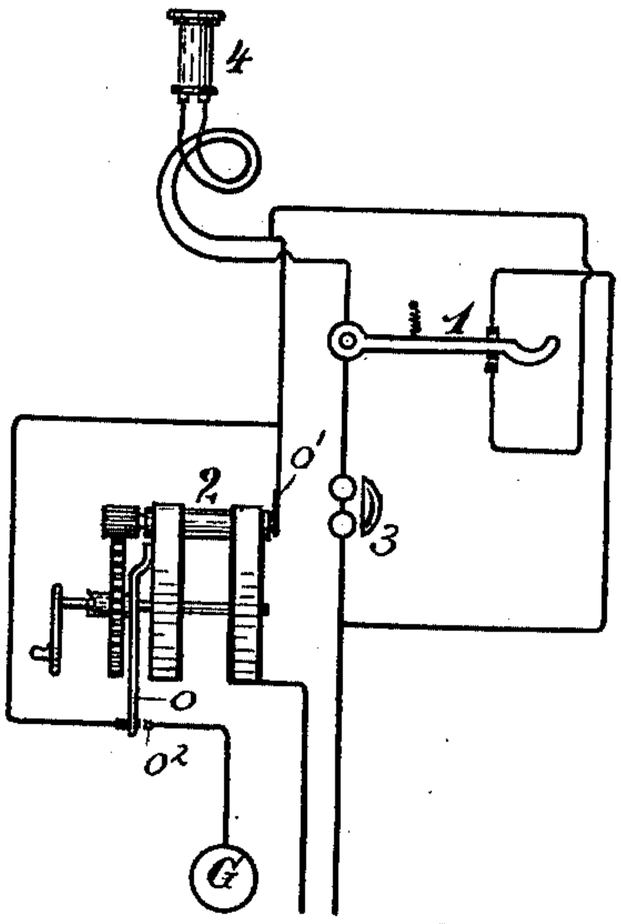


Fig. 4.



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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. 592,341, dated October 26, 1897.

Application filed December 21, 1889. Serial No. 334,518. (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 parts of the lines are metallic-circuit lines and part of them are single-circuit lines; and it consists of apparatus for and a system of 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. 3 shows a diagram of an operator's cord system to be used in connection with the boards. Fig. 4 shows a subscriber's-station apparatus to be used on the metallic-circuit lines. Fig. 5 shows an operator's test system.

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 bears on an insulated contact-point and has a contact-piece insulated from the rest (except by the circuit connections) and is adapted to receive a loop-switch plug and, where a plug is inserted, to disconnect the spring from the contact-point (on which it normally bears) and connect the two contact-pieces of the plug with the spring and said insulated contact-piece, respectively.

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 insulated contact-pieces of the switches. *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 that a test-plug or similar device may readily be applied to them. 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 *j* are in contact with the two contact-pieces, respectively, of the plug.

w and *x* are the line-annunciators for the two lines shown.

R is a rheotome or mechanical circuit-breaker containing a clockwork-movement actuated by a spring. It contains an oscillating bar fixed to the verge-shaft and standing at right angles to it. A pair of contact-points is connected with the bar or with the shaft in such a way that their contact is alternately made and broken with the oscillations. The pair of contact-points are properly insulated and are connected into the circuit, as indicated, for the rheotome. Instead of the rheotome shown any form of mechanical or electrical rheotome or any apparatus which changes the electrical condition of the line so that the change will be indicated on the test receiving instruments may be connected into the circuit, as indicated, for the rheotome.

Two lines are shown in Fig. 2, one of them a metallic-circuit line, the two sides or branches of which are marked line No. 1^a and line No. 1^b, respectively, and the other a single-circuit line marked line No. 2.

The circuit of the single-circuit line is as follows: from the subscriber's ground, through his station apparatus, (which may be of the usual form of apparatus,) thence through the line and the pairs of switch contact-points *g h* of the switches, successively, of its switches on the several boards, going in each case to the point *h* first, and thence through the line-annunciator to the common wire of the lines in which is the rheotome. This common wire is grounded, with the rheotome between the

ground and the connections of the lines with it. All the contact-pieces *j j* of the switches of the line are connected together and to the line, the connection being between the switch contact-points and the subscriber's station.

The circuit of a metallic-circuit line is as follows: One side or branch of the line—say line No. 1[a], as shown—is connected with all the contact-pieces *j j* of its switches on the boards. The other branch of the line—say line No. 1[b]—passes successively through the pairs of contact-points *g h* of its switches on the several boards, passing in each case to the spring first. It then passes through its annunciator to the common wire, in which is the rheotome.

In the subscriber's-station apparatus for metallic-circuit lines (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 results. 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 modification consists, essentially, in the number and arrangement of the contact-points of the automatic device. The automatic device shown is a modification of a form very generally used. It consists in a V-shaped attachment to the hub of the driving-wheel, a pin in the shaft, which engages in this V-shaped arrangement, and a spring which presses against the wheel and brings the pin normally in the center of the V-shaped arrangement. The contact-points and circuits are substantially as shown. One side or branch of the line connects with the frame of the generator, as does also one end of the armature-coil and the spring *o* of the automatic device. The other side or branch of the line connects to the insulated spring *o'*, which bears on an insulated piece on the armature-shaft, to which the other end of the armature-coil is connected. The contact-point with which the spring of the automatic device is pressed into contact when the generator is operated is connected to the ground. The side or branch of the line which is grounded at the central office is the one connected to said insulated spring *o'* of the generator.

In the operator's cord system shown in Fig. 3, D D are two loop-plugs. Y is a looping-in switch for the plugs, and *v* a clearing-out annunciator. *t* is the operator's telephone, and B is her calling-generator. *m m'* are the two contact-pieces of the plug. They extend to the bottom of the plug, as shown, and normally rest on the metal piece *o*, which thereby then brings them into electrical connection. The contact-pieces *m' m'* of the two plugs are connected to the two levers of the switch Y by flexible conductors, as shown. The other contact-pieces of the plugs *m m* are connected to the ground through flexible conductors, as shown. Only one pair of plugs, with their cords, switch, and clearing-out annunciator, is shown. Other pairs may be added to the system in a manner which will be apparent to those skilled in the art.

In the operator's test system shown in Fig. 5, T is the test-plug, connected by a flexible conductor to the test receiving instrument S, and thence through the test-battery B' to the ground.

The test receiving instrument is of such a character that it will respond to variations in the strength of the test-current. In the drawings a testing-bell is shown with its armature supported in air by a spring only, so that as the current grows stronger or weaker the armature will vibrate. The test receiving instrument universally used in telephone-exchanges is the operator's head telephone, and such a device may be used with this exchange.

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

The switching between the various lines of the exchange is as follows: When an operator receives a call on a single-circuit line assigned to her board, she places one of the plugs of her system into the switch of the line, so that the piece *m'* is in contact with the switch-piece *j*, and placing the levers of the switch Y so that her telephone is in circuit finds out, by conversation, what line is wanted. The circuit of the line is complete to the ground through the connection between the contact-pieces of the other plug by means of the piece *o*, on which they normally rest. When she finds out what line is wanted, she tests it, as will hereinafter be described, and if she finds it to test "free" she places the other plug of the pair into its switch, so that the contact-piece *m'* of the plug is in connection with the contact-piece *j* of the switch. If the second line is also a single-circuit line, the circuit is complete between the two lines from the subscriber's ground of one line through the switch-cords connected to the plug-contacts *m' m'* to subscriber's ground of the other line. If the second line is a metallic-circuit line, there is a complete circuit as follows: from the ground of the single-circuit line through the circuit of the line, the contact-pieces *m' m'* of the plugs used, and the cords connecting them together, through the circuit of the metallic-circuit line to the contact-piece *m* of the plug which is in its switch, and thence to the ground through the cord conductor which is connected with the piece. When an operator receives a call on a metallic-circuit line assigned to her board, she places one of the plugs of her system into the switch of the line, and placing the levers of the switch Y so that her telephone is in the circuit finds

out, by conversation, what line is wanted. The circuit of the line is complete when the plug is in the switch, because the two contact-pieces of the other plug of the pair are connected or bridged by means of the metal piece *o*, on which they rest. When she finds out what line is wanted, she tests it to see whether it is busy or not, and if it is not busy she places the other plug of the pair into its switch at her board. If the line which she connects to is a single-circuit line, she places the plug in its switch so that the contact-piece *m'* is in connection with the piece *j* of the switch. There is a complete circuit of the two lines from the subscriber's ground, the contact-pieces *m' m'* of the two plugs, and the cord connecting them together, thence through the circuit of the metallic-circuit line to the contact-piece *m* of the plug which is inserted into its switch, and thence to the ground through the cord which is connected with the piece. If the line which she connects to is also a metallic-circuit line, the lines are connected into a complete circuit as follows: from the ground through one contact-piece *m* to one line, thence through the circuit of the line, the contact-pieces *m' m'*, and the cords which connect them to the other line, thence through the circuit of the other line and the contact-piece *m* of the plug connected with it back to the ground.

In each case where a plug is inserted into the switch of a single-circuit line it is so inserted that the contact-piece *m'* is in connection with the contact-piece *j* of the switch. The other contact-piece of the plug is then connected with the ground, but it does not affect the operation of the system.

When any line in the system, whether single or metallic circuit, is not switched for use, there is a complete circuit from its contact-pieces *j j* and the switch contact-points *g h* of the line to the rheotome and thence to the ground; but when the line is switched at any board the circuit to the rheotome and ground is interrupted at the pair of contact-points *g h* used. It follows that when the operator applies her test-plug (grounded through her test receiving instrument and battery, and the instrument and battery constructed so that the instrument will sound or respond when they are on closed circuit with the rheotome to its vibrations) and the instrument responds that the line is not switched at any board, and when it does not respond that the line is switched at some board. The operator can therefore determine, on testing, whether or not a line is switched.

The test-circuit of a single-circuit line may be traced from the grounded operator's test outfit through the two branches of the line, one branch including the line conductor and the ground at the subscriber's station and the other branch including the switch-contacts and the office ground through the rheotome. The presence of the rheotome in one of these branch circuits causes a variation in the strength of the test-current passing through the test receiving instrument.

The test-contacts are connected to the line conductors permanently or under all conditions, whether the line is or is not switched for use.

It will be seen from the description of the system of switching and testing, as above described, that the operators can make all the necessary connections and testing for a telephone system with combined single and metallic circuit lines, that the operations they go through with for each connection are the same whether the lines switched be single-circuit or metallic-circuit lines, and that the switches required for the two kinds of lines are the same. The confusion and trouble which would arise from two systems of switching and testing and two forms of switches for the two kinds of lines is avoided. This result is obtained by the combination of apparatus and circuits I have shown and described.

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

1. In a telephone-exchange system, a subscriber's line permanently grounded at its outer end in combination with a switch for the line into which a double or loop plug is placed, said switch containing a contact-piece permanently connected to the line and a pair of contact-pieces which are normally in contact but which are separated by the plug on its insertion, one of said pair being connected to the line and the other, the third, being connected with the ground, one of the two contact-pieces of the plug being connected to a contact-piece of another plug and while inserted into the switch forming connection with said first contact-piece and the other contact-piece of the plug forming connection with said third-mentioned contact-piece of the switch, respectively, substantially as set forth.

2. In a telephone-exchange system, a pair of double or loop plugs, one of the contact-pieces of each of which is connected with one of the contact-pieces of the other, through flexible conductors, and the other contact-pieces of which are connected with the ground through flexible conductors, and a metal contact-piece which, when the plug is in its normal position (or not in use for switching) connects the two contact-pieces of the plug together, (but not otherwise,) in combination with a subscriber's line grounded at its outer end, a switch for the line into which the other plug is placed, and which then connects the line with said first-mentioned contact-piece of the plug, and an operator's telephone between the first-mentioned contact-pieces of said plugs, substantially as set forth.

3. In a telephone-exchange system, a pair of double or loop plugs, one of the contact-pieces of each of which is connected to one of the contact-pieces of the other, through flexible conductors, and the other contact-pieces of which are connected to the ground through flexible conductors, and a metal con-

tact-piece which, when a plug is in its normal position (or not in use for switching,) connects the two contact-pieces of one plug together, (but not otherwise,) in combination with a single-circuit line grounded at its outer end, a switch for the line into which the other plug is placed, said switch containing a contact-piece connected permanently to the line and two other contact-pieces which are normally in contact, but which are separated by the plug on its insertion, one of the two pieces being connected to the line and the other to the ground, the first-mentioned contact-piece of said other plug, when thus inserted, being connected to the first-mentioned contact-piece of the switch and the other contact-piece of the plug being connected with the ground contact-piece of the switch, and an operator's telephone between the first-mentioned contact-pieces of said plugs, substantially as set forth.

4. In a telephone-exchange system, a subscriber's line permanently grounded at one end and normally grounded at the central office at the other end, in combination with a switch for the line into which a loop-plug is placed, said switch containing two contact-pieces normally in the circuit of the line and in contact when the plug is not in the switch but not otherwise, and a third contact-piece permanently connected with the line, one of the contact-pieces of the plug being connected to a contact-piece of another plug and when thus inserted forming connection with said third contact-piece and the other contact-piece of the plug forming connection with the contact-piece of the switch which is grounded through the cut-off portion of the line, substantially as set forth.

5. In a telephone-exchange system, a subscriber's line permanently grounded at its outer end, in combination with switches for the line, one on each of several switchboards and into each of which double or loop plugs may be placed for switching, each switch containing a contact-piece permanently connected with the line and two other contact-pieces normally in contact but open while a plug is in the switch, said line passing, successively, through the pairs of contact-pieces and thence to the ground, one of the contact-pieces of a plug being connected to a contact-piece of another plug and while inserted forming connection with said first-mentioned contact-piece of the switch and the other contact-piece of the plug forming connection with the contact-piece of the switch, which is then connected with the ground substantially as set forth.

6. In a telephone-exchange system a subscriber's line, in combination with switches for the line, one switch on each of several boards, and into which double or loop plugs may be placed for switching, two contact-pieces normally in contact but open while a plug is in the switch, said line passing, successively, through the pairs of contact-points, and a contact-piece connected to the line between said pair of contact-points and the subscriber's station, one of the contact-pieces of a plug being connected with a contact-piece of another plug and while inserted forming connection with said last-mentioned contact-piece of the switch and the other contact-piece of the plug forming connection with the contact-piece which is connected with the cut-off portion of the line, substantially as set forth.

7. In a telephone-exchange system a subscriber's line grounded at its outer end, in combination with a switch for the line into which a double or loop plug is placed for switching, said switch containing a contact-piece permanently connected with the line and two other contact-pieces which are normally in contact, but which are separated by the plug on its insertion, one of the pieces being connected with the line and the other with the ground, one of the contact-pieces of the plug being connected with a contact-piece of another plug and the other being connected with the ground through flexible conductors, said first-mentioned contact-pieces of the plug and switch, and said last-mentioned contact-pieces of the plug and switch, being connected together respectively, while the plug is inserted, substantially as set forth.

8. In a telephone-exchange system, a subscriber's line grounded at its outer end, in combination with switches for the line, one switch on each of several boards, and into each of which double or loop plugs may be placed for switching, each switch containing a contact-piece permanently connected with the line and two other contact-pieces normally in contact but open while a plug is in the switch, said line passing, successively, through the pairs of contact-points and thence to the ground, one of the contact-pieces of each switch-plug being connected with a contact-piece of another plug and the other contact-piece being connected with the ground, through flexible conductors, said first-mentioned contact-pieces of a plug, on its insertion into a switch, forming connection with said first-mentioned contact-piece of the switch and the other contact-piece of a plug forming connection with the contact-piece of the switch which is connected with the ground, substantially as set forth.

9. In a multiple-switchboard exchange, a single-circuit line having a common return-conductor, a jack-contact at two or more boards, permanently connected to said single line, a metallic circuit, loop-switch apparatus having two cord conductors, one adapted to connect a contact of said single line to one limb of said metallic circuit, and the other adapted to connect the other limb of said metallic circuit to said return-conductor.

10. In a multiple-switchboard exchange, two or more metallic circuits, two or more single-line circuits having a common return, a jack-contact at each board, permanently

connected to each of said single lines, loop-switch apparatus having two cord conductors adapted to connect any two of said circuits together, so constructed that when two metallic circuits are connected together the two limbs of one are connected to the two limbs of the other by said two cord conductors respectively, and when a metallic circuit and a single circuit are connected together one of the jack-contacts of said single circuit is connected to one side of said metallic circuit by one of said cord conductors, and the other side of said metallic circuit is connected to said common return by the other of said cord conductors.

11. In a multiple-switchboard exchange, two or more single-line circuits having a common return, a jack-contact at each board permanently connected to each of said single-line circuits, two or more metallic circuits connected to said boards, the two limbs of each metallic circuit connected to two contacts respectively in each jack, loop-switch apparatus comprising two plugs each having two contacts connected together through two flexible cord conductors, one cord conductor adapted to connect the jack-contact of one of said single circuits with one limb of one of said metallic circuits and the other cord conductor adapted to connect the other limb of said metallic circuit to the common return-conductor, and said loop-switch apparatus also adapted to connect together the two limbs of two metallic circuits.

12. In a multiple-switchboard exchange, a single-circuit telephone-line having a common return, a contact in each of several jacks permanently connected to said line, normally closed pairs of contacts in said jacks through which the line is normally connected to said common return and disconnected by the insertion of a switch-plug; a metallic-circuit, loop-switch apparatus having two cord conductors, one cord conductor adapted to connect a permanently-connected jack-contact of the single-circuit line with one limb of said metallic circuit, and the other cord conductor adapted to connect the other limb of said metallic circuit to said common return.

13. In a telephone-exchange, a single-circuit line, an operator's set, loop-switch apparatus adapted to connect said set to said single line, comprising two plugs, one carrying a contact adapted to make connection with said line, the other carrying two contacts normally cross-connected by a conducting base-plate, one of said contacts connected through the operator's set to the said contact of the first-mentioned plug, and the other contact connected to the return-conductor of said single-circuit line.

14. In a multiple-switchboard exchange, a single-circuit line continuous in the order named from a common conductor through a subscriber's outfit, a line conductor, electrically-united test-contacts, one at each board, normally closed jack-contacts, a set at each board, and a connection to said common conductor, and metallic circuits continuous in the order named from electrically-united test-contacts one at each board, metallic line conductors including a subscriber's outfit, normally closed jack-contacts, a set at each board, and a connection to said common conductor; in combination with loop-switching apparatus having two cord conductors adapted to connect said circuits, and thereby open a set of normally closed contacts, and test outfits, one at each board, including a test receiving instrument adapted to be connected to a test-contact of either line and thereby establish a circuit for testing while the line is not switched for use, but not otherwise.

15. In a multiple-switchboard exchange, single-circuit lines, each continuous in the order named from a return-conductor through a subscriber's outfit, a line conductor, test-contacts, one at a jack at each board, normally closed contacts, a set in a jack at each board, a rheotome, and a connection to said return-conductor; and metallic circuits each continuous in the order named from test-contacts, one in a jack at each board, metallic line conductors, including a subscriber's outfit, normally closed contacts, a set in a jack at each board, a rheotome, and a ground connection; in combination with loop-switching apparatus comprising two plugs each having two contacts, a contact of one plug connected to a contact of the other plug through a flexible conductor containing an operator's set, the other contacts of the two plugs connected together through a flexible conductor connected to said return-conductor, thus adapted to connect together any two of said circuits, and operator's test outfits, one at each board, adapted to be connected to a test-contact of any line for testing, each outfit including a test-plug, a test receiving instrument and test-battery, in a circuit connected to said return-conductor.

In witness whereof I hereunto subscribe my name this 29th day of November, 1889.

MILO G. KELLOGG.

Witnesses:
EMIL ABENHEIM,
MARGARETHA RIEHL.