(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,400. Patented Oct. 26, 1897.

Fig. 1.

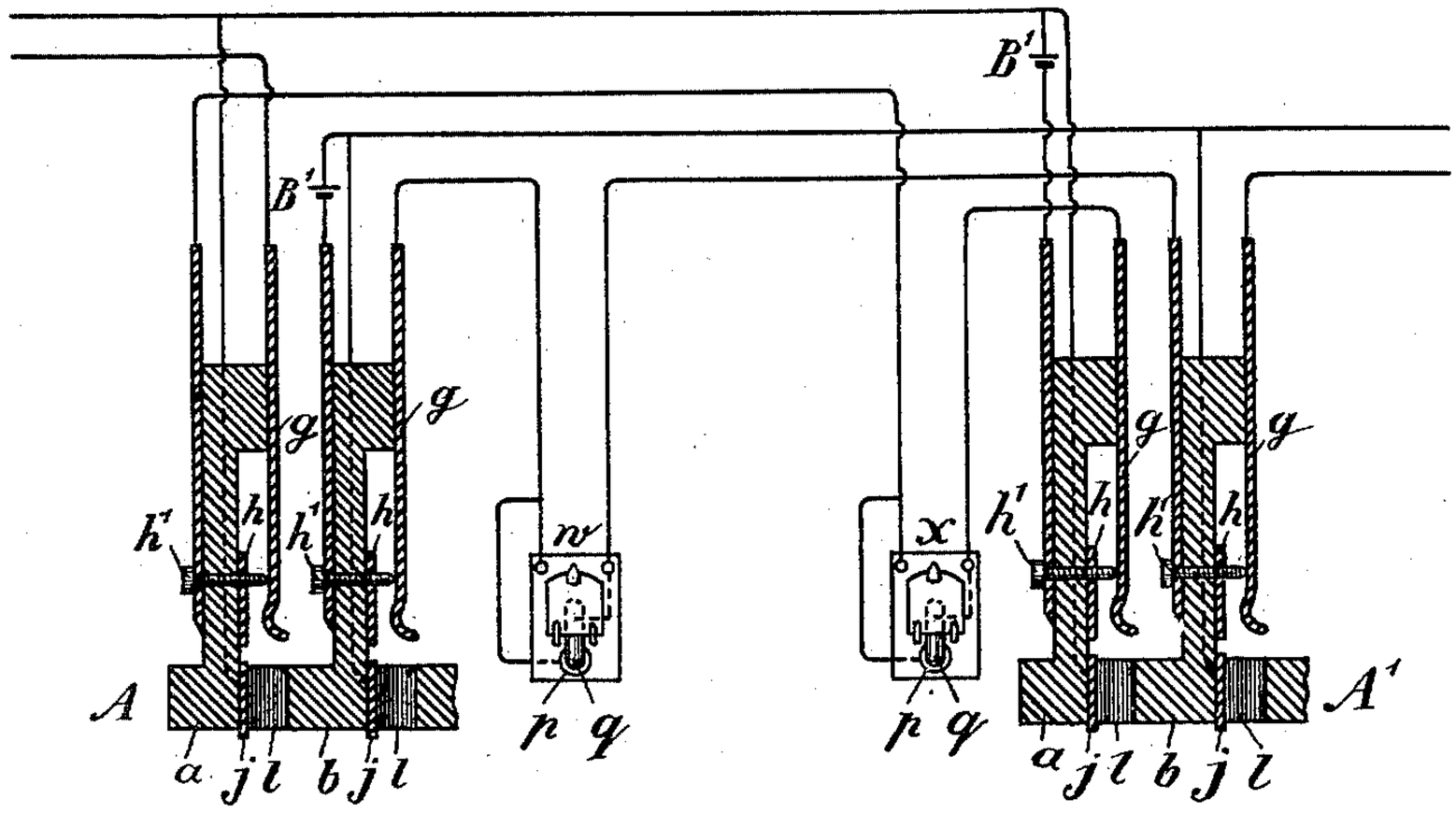


Fig. 2.

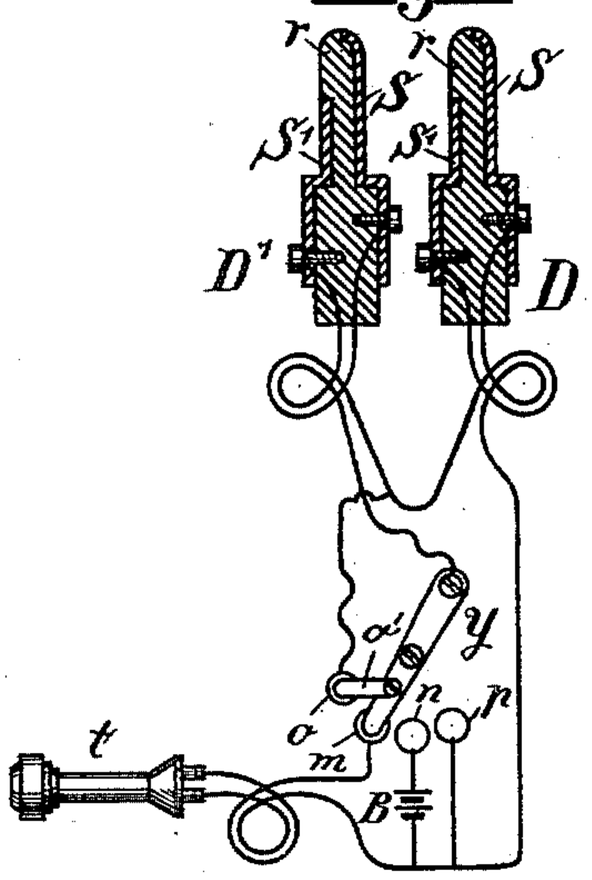


Fig. 3.

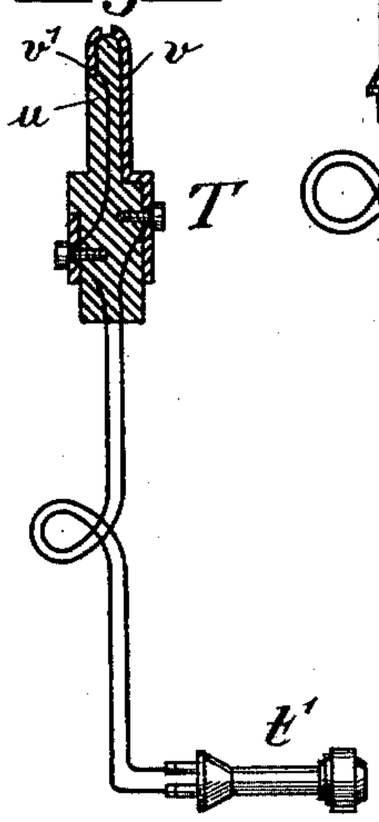
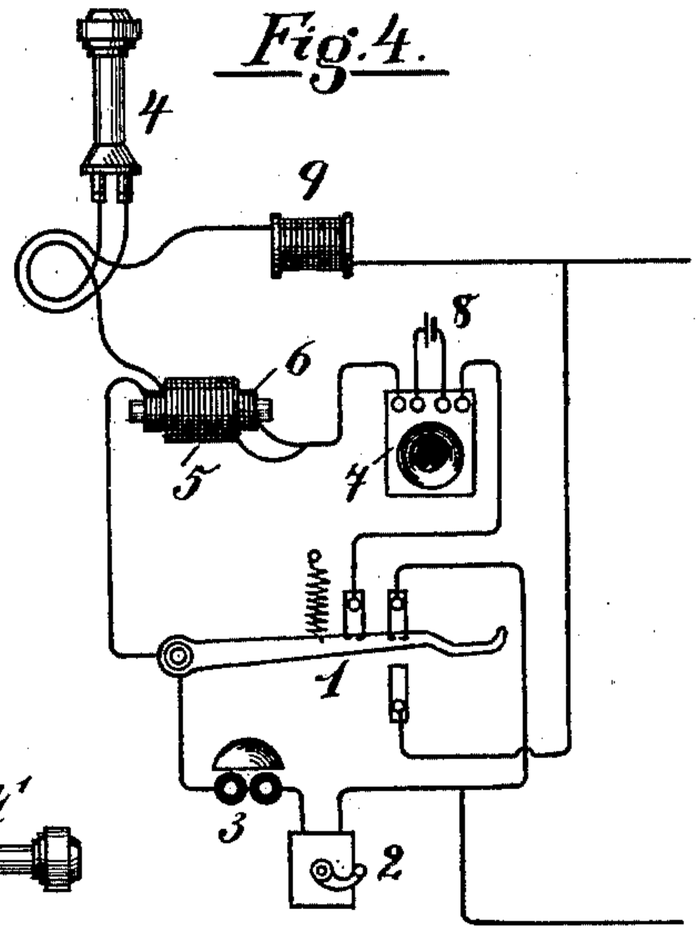


Fig. 4.



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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. 592,400, dated October 26, 1897.

Application filed May 19, 1891. Serial No. 393,271. (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, have invented certain new and useful Improvements in Multiple Switchboards for Telephone-Exchanges, of which the following is a full, clear, concise, and correct description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a telephone-exchange system in which the lines are metallic-circuit lines and in which the necessary switching between the lines is accomplished by means of pairs of double or loop plugs connected together by double flexible conductors.

It consists, first, of a system of testing the lines at any board to determine whether or not they are in use; secondly, of an organization of switches and connections for said cords by which the movements required of the operator in making the necessary connections and disconnections are few and convenient to make, and, thirdly, of an arrangement of annunciators and switches of the different lines by which special clearing-out annunciators are not required.

In the accompanying drawings, illustrating my invention, Figure 1 represents sectional views of sections of two multiple switchboards and the main-line central-office connections and apparatus of the two lines connected to the two switchboards. Fig. 2 represents a diagram of an operator's cord system and apparatus necessary to illustrate my invention. Fig. 3 represents an operator's test system. Fig. 4 represents a subscriber's-station apparatus necessary to illustrate my invention.

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 switch for each line.

Each switch has a contact-spring which normally connects with a contact-point and is separated from the point while a plug is inserted into the switch and has a contact-piece insulated from the rest, except by the circuit connections. To the contact-point is attached an extension piece or connection along the surface of the switch-hole, by means of which one of the contact-pieces of the loop test-plug, hereinafter described, forms connection with the contact-point when the plug is inserted, as hereinafter described. The insulated contact-piece mentioned above is also placed along the surface of the switch-hole, and preferably in front of said extension-piece to the contact-point, and is so placed that one of the contact-pieces of the loop-switch plugs, hereinafter described, forms connection with said contact-piece when the plug is inserted. Said plugs are so constructed and said contact-pieces and extension-pieces of the switches are so placed that when the test-plug is inserted into a switch the contact-piece of the plug does not come into contact with said contact-piece and when a switch-plug is inserted into a switch the contact-piece of the plug does not come into contact with the extension piece or point of the switch.

In Fig. 1, A A′ are sectional views of sections of the two switchboards shown. *g g* represent the springs of the different switches; *h′ h′*, the contact-points of the switches on which the springs normally rest, and *h h* the extension-pieces of the points placed along the surface of the holes of the switches in front of the points. *j j* are the insulated contact-pieces of the switches also placed along the holes of their respective switches, and preferably in front of the extension-pieces. *a b* are rubber strips on which the metal parts of the switches are mounted and through the fronts of which are the switch-holes *l l*. These holes are rectilinear holes and are adapted to receive the loop-plugs mentioned above and to cause them to operate the switches, as described. W and X are calling-annunciators, one for each line shown and each with contact-points and connected into the circuit of its line, as will hereinafter be described. B′ B′ are test-batteries, one for each line and each connected into the circuit of the line, as will hereinafter be described.

Two metallic-circuit lines are shown in the drawings, and they are connected to their respective boards as follows and as shown: One side or branch of the line is connected to the contact-pieces *j j* of its switches on the several

boards. The other side or branch of the line passes successively through the pairs of contacts *g h* of its switches on the several boards, passing in each case to the spring first. It then passes through the test-battery of the line, and is then connected to the other side or branch of the line to which the contact-pieces *j j* are connected. The annunciator of the line is placed in the circuit between the last pair of contact-points before the two branches are united and the pair of points immediately preceding the last pair and is located at the same board as said last pair of contact-points.

The two branches of the line are normally on closed circuit at the subscriber's station.

In the operator's cord system shown in Fig. 2, D D′ are a pair of loop-switch plugs adapted for use with the switches shown in Fig. 1. *r r* are the rubber insulations of the plugs. *s s′* are the two contact-pieces of the plug. The plugs are constructed and the contact-pieces are arranged so that when a plug is inserted into a switch the spring is pressed away from its contact-point, the contact-piece *s* forms connection with the spring *g*, the contact-piece *s′* forms connection with the contact-piece *j* of the switch, and the contact-point *h′* is insulated from the contact-pieces of the plug. The plugs should be inserted into the switches in such a direction that they form the connections as above described.

The annunciators shown are of a form in very common use, each with two contact-points which are normally out of contact, but which are pressed into contact by the annunciator-drop when it falls and indicates a call. The connections of the contact-points are as follows: One contact-point is connected to the line-circuit on one side of the annunciator-magnet and the other point is connected to the line-circuit on the other side of the magnet. When the annunciator indicates a call, its magnet is therefore shunted by a circuit of small resistance and is practically cut out of the circuit of the line.

Y is the operator's switch for the pair of cords shown. *t* is the operator's telephone, and B is her calling-generator. The switch has a lever and three contact-points, on which the lever may be alternately placed at the will of the operator. One of the contact-points is marked *m*. The point adjoining *m* is marked *n*, and the other point (which adjoins *n*) is marked *p*.

One of the contact-pieces of one plug is connected to one of the contact-pieces of the other plug of the pair by a flexible conductor. The other contact-piece of the plug D′ is connected to the lever of the switch by a flexible conductor, and the other contact-piece of the plug D is connected through a flexible conductor to one side of the operator's telephone, to one side of her calling-generator, and to the circuit-point *p* of the switch. The other side of the operator's telephone is connected to point *m* of the switch, and the other side of her generator is connected to point *n*.

o o′ are a pair of contact-points, of which *o* is a stationary point and is connected by a circuit-wire to the cord-circuit which connects the two contact-pieces of the plugs which are not directly connected to the switch parts, and *o′* is a contact-point which is connected to the lever of the switch, as shown, and moves with the lever. The contact-points *o o′* are in contact when the switch-lever is on the contact-point *m* and are out of contact when the lever is moved to the other points of the switch.

The contact *o′* should be so placed that it will not make contact with *m* or *n* when the switch-lever is moved from its normal position.

Only one pair of switch-plugs, with their cords and switch, are shown. Other pairs, as are found desirable, may be added to the operator's system in a way which will be apparent to those skilled in the art. She needs but one telephone and calling-generator.

The lever of each operator's switch normally rests on the contact-point *m*.

In the operator's test system shown in Fig. 3, T is the loop test-plug, and *t′* is the test receiving instrument, which may be any suitable instrument, such as will hereinafter be described. *u* is the rubber insulation of the plug, and *v v′* are its contact-pieces. The plug is constructed and the pieces are arranged so that when the plug is inserted into any switch the spring is pressed away from its contact-point, the contact-piece *v* forms connection with the spring *g*, the contact-piece *v′* forms connection with the extension-piece *h*, and the contact-piece *j* of the switch is not in contact with the contact-pieces of the plug. The plug should be inserted into the switches in such a direction that they form the connection as above described. The two contact-pieces *v v′* of the plug are connected by a flexible conducting-loop in which is the test receiving instrument.

Each operator has a cord system and a test system, and they are conveniently mounted at her board for her work. The conducting-cords of the plugs should be long enough so that she can connect any plug with any switch at her board.

In the subscriber's-station apparatus shown in Fig. 5, 1 is the telephone-switch. 2 is the calling-generator. 3 is the signal-receiving bell. 4 is the subscriber's telephone. 5 is the secondary, and 6 is the primary, of the induction-coil. 7 is the transmitter. 8 is the transmitter-battery. 9 is a resistance-coil of suitable resistance to operate as hereinafter described. These parts may be of usual forms of apparatus and are connected as shown or in other ways so as to perform practically the operations required and the operations hereinafter described.

When the subscriber's telephone is on its switch, the signal-receiving bell is in the cir-

cuit of the line and the telephone, the secondary of the induction-coil, and the resistance-coil are shunted by a wire of small resistance, so as to be practically out of the circuit. When the telephone is off the switch, the telephone, the secondary of the induction-coil, and the resistance-coil are in the circuit and the signal-bell is practically out of the circuit. The resistance of the telephone and secondary of the induction-coil combined aggregate in well-constructed apparatus about four hundred ohms and the resistance of the signal-bell amounts to about one hundred ohms. The resistance switched into the circuit when the telephone is off its switch for use is therefore much greater than is the resistance in the circuit when the telephone is in its normal position on the switch. I utilize this difference in resistance in the operation of the test system, as will hereinafter appear. If the difference in the resistance when the telephone is off its switch for use and when it is in its normal position on the switch is not sufficient to secure an easy adjustment of the test apparatus to the circuits, such additional resistance as is required may be placed in the resistance-coil 9. Whether this artificial resistance is used and its amount, if used, will depend on the apparatus and circuits to which the system may be applied.

The test receiving instruments and test-batteries should be so constructed and adjusted to each other and the circuits that the instrument will sound or respond when it and the battery are looped into the closed circuit of any single line and the subscriber's telephone is not off its switch for use and the resistance of its circuit is therefore comparatively low, but will not respond if the circuit is open at any point or if the subscriber's telephone is off its switch and the additional resistance at the subscriber's station is included in the circuit or the line is switched with another line and thereby has its test-circuit open, as will hereinafter be indicated. This adjustment can be regulated as required by the addition of artificial resistance in the circuits. The adjustment is therefore a marginal adjustment by which the test receiving instrument sounds when placed in closed circuit with the test-battery and the normal circuit of the line with its comparatively small resistance, but does not sound when the resistance is considerably increased, although current is still passing through the instrument. This construction and marginal adjustment depends on the fact that an electromagnet may be readily made so as to operate when a battery and a certain resistance are in circuit with it and not to operate when the resistance is considerably larger. This operation can be obtained in different ways, dependent on the style of the electromagnet, the number of convolutions of its coil, the size of the battery, and the adjustment of the retractile spring. These parts should be such that the electromagnet will be actuated when the test system is looped into the simple circuit of any line of the exchange, but will not be actuated when the additional resistance is introduced. The resistance of the coils may be such as is necessary or desirable in order to obtain such an adjustment of the parts of the exchange system.

The operation of the switch system is as follows: When an operator receives a call on the annunciator of a line, she places the plug D of a pair of her plugs in the switch of the line. By so doing she opens the closed circuit of the line and loops her telephone into the circuit. The closed circuit of the line is opened at the pair of contacts *g h* of the switch. The two cords of the plug are connected to the two branches of the line by the connection of the two contact-pieces of the plug with the two contact-pieces *g* and *j* of the switch, and the two cords are bridged or connected by the contacts *o o'* of the cord-switch. When the operator finds out by conversation what line is wanted, she tests the line wanted, as will be hereinafter described, and if she finds it is not busy she places the plug D' of the pair in the switch of the line, opening the closed circuit of the line and connecting its two branches to the cord-circuits of the plug. She then moves the lever of the cord-switch so that it rests on the point *n*. By so doing the bridge connection between the cords at *o o'* is removed and a signal-current from the operator's generator goes to the metallic circuit. She then moves the lever of the switch so that it rests on *p* and the lines are connected in metallic circuit for conversation. When the operator receives the clearing-out signal, she will remove the plugs from the switches and move the lever of the cord-switch so that it rests on the point *m*, when they are ready to be used for another connection.

The operation of the test system is as follows: When an operator desires to test a line, she places her test-plug into the switch of the line, and by so doing disconnects the points *g* and *h* of the switch and connects them with the contact-pieces of the plug. If, then, the line is not switched at any board and the subscriber's telephone is on its switch, the test receiving instrument will sound or respond, because it is in closed circuit of comparatively small resistance in which is included a test-battery, thus indicating that the line is free to be switched to. If, however, the subscriber has taken his telephone from the switch for use, the instrument will not sound, as the additional resistance in the circuit will prevent it from doing so. If, again, the line is switched at some board and the test is made in the cut-off portion of the line—that is, that portion which is between the switch used for switching and the last switch from the subscriber's station—the instrument

will not sound, because the test-circuit is open at the pair of contact-points of the switch used for switching.

If, again, the line is switched at any board with another line and the test is made in some switch between the one used for switching and the subscriber's station, the instrument will not sound on account of the battery being cut off from the circuit in which the test receiving instrument is included.

When a test of a line is made and the test receiving instrument sounds, the operator knows that neither the line is switched for use nor the subscriber's telephone is switched for use, and when the instrument does not sound she knows that either the subscriber's telephone is switched for use or the line is switched for use and she will not connect the line with any other line.

By this system a subscriber's line is reserved to himself from the time he takes his telephone from its switch or the line is switched for use.

When a call is received on a line and it is answered and the line is connected with another line whose calling-annunciator is located on another board, the annunciator of the line in which the call originated is in their circuit and the annunciator of the other line is not included in the circuit. When the two lines have their annunciators at the same board, the operator will leave one of the drops down, and its magnet is thereby shunted from the circuit and the magnet of the other line is in the circuit of the two lines connected together. In either of the cases one of the annunciators is in the circuit of the lines at the board where the connection is made and a clearing-out signal will be received on it and attended to by the operator, and the other annunciator is either out of the circuit or shunted so as to be practically out of it. This system therefore provides a clearing-out annunciator in the circuit of any two lines connected together without requiring a special clearing-out annunciator for each pair of cords.

When two lines are connected together for conversation and the annunciator of one of the lines is in circuit with them for clearing-out purposes, as pointed out, the combined circuit is one of metallic continuity throughout unobstructed by condenser or other forms of break, whether either subscriber's telephone is on its switch or not, so that any clearing-out current sent by either subscriber has a free unobstructed and unbroken circuit to operate the annunciator in and cause the clearing-out signal to be operated.

In multiple-switchboard systems an operator to whom certain lines are assigned to answer frequently receives several calls at practically the same moment, and it may require some time before she can switch to a certain line and answer its call. In systems in which the test depends only on the line being switched at some board another operator may in the meantime test the line, and, finding it to test "free," may switch it with another line and cause annoyance and confusion to the subscriber. This cannot occur in this system of testing, because as soon as the subscriber takes his telephone from its switch the line will test "busy" whether or not it is switched at the central office. Again, in systems of testing which depend only on the subscriber's telephone being on or off its switch confusion frequently arises from the fact that a subscriber places his telephone on its switch when he is through conversation without sending in a clearing-out signal, and his line tests "free" and is "connected to" when it is already switched with another line. Lines in this condition are technically called "tied up." This, again, cannot occur in this system, because the line will test "busy" until it is disconnected at the central office whether or not the subscriber's telephone is on its switch. The system therefore combines the advantages and obviates the disadvantages of the two general systems of testing outlined above.

I claim as my invention—

1. In a telephone-exchange system, multiple switchboards metallic-circuit lines, switches for said lines one switch for each line on each board, one side or branch of each line passing successively through pairs of contacts of the line-switches on the several boards and from the last contact-point through a test-battery to contact-pieces, one for each switch of the line, and to the other side or branch of the line, in combination with pairs of double or loop-switch plugs at each board, the two contact-pieces of one plug being connected by flexible conductors to the two contact-pieces of its mate, adapted to be inserted into the switches and when a plug is inserted into a switch to disconnect the pair of contact-points and connect one of the contact-pieces of the switch-plug with that contact-point which is connected with said first-mentioned side or branch of the line, while the other contact-piece of the plug forms connection with said contact-piece of the switch, test receiving instruments, one at each board, each connected on its two sides to the two contact-pieces of a loop test-plug adapted to be inserted into any switch at its board and when inserted to disconnect the pair of contact-points of the switch and form connection between them and its two contact-pieces, resistances at each subscriber's station and switches with contact-points to switch a greater resistance into the circuit of a line when its subscriber's telephone is switched for use than when it is not thus switched, said instruments and batteries being so adjusted to each other and the lines that an instrument sounds when included in the normal closed circuit of a line but does not sound when on open circuit with the battery or on closed circuit with the line and its

battery with the additional resistance in the line on the telephone being switched for use, substantially as set forth.

2. In a telephone-exchange system, a pair of loop-switch plugs, in combination with a switch for said pair of plugs and an operator's telephone, said switch having a lever, two contact-bolts with which said lever connects in one of its positions and another contact-bolt with which the lever connects in another of its positions, two contact-pieces of the plugs, one of each plug, being connected together by a flexible cord conductor and said conductor being connected to one of said two contact-bolts, the other of said two bolts being connected through the telephone and the last-mentioned bolt being connected but not through the telephone, by a flexible conductor, with one of the other contact-pieces of the plugs, while the remaining contact-piece of the plugs is connected by a flexible conductor with the switch-lever, substantially as set forth.

3. In a telephone-exchange system, a pair of loop-switch plugs, in combination with a switch for said pair of plugs, a calling-generator and an operator's telephone, said switch having a lever, two contact-bolts with which said lever connects in one of its positions, another contact-bolt with which the lever connects in another of its positions and another contact-bolt with which the lever connects in another of its positions, two contact-pieces of the plugs, one of each plug, being connected together by a flexible cord conductor and said conductor being connected to one of said two contact-bolts, the other of said two bolts being connected through the telephone, the second-mentioned bolt being connected through the generator and the last-mentioned bolt being connected but not through the telephone or generator by a flexible conductor with one of the other contact-pieces of the plugs while the remaining contact-piece of the plugs is connected by a flexible conductor with the switch-lever, substantially as set forth.

4. In a telephone-exchange system, a pair of loop-switch plugs, in combination with a switch for said pair of plugs, a calling-generator, and an operator's telephone said switch having a lever, two contact-bolts with which said lever connects in one of its positions, another contact-bolt with which the lever connects in its next position and another contact-bolt with which the lever connects in its next position, two contact-pieces of the plugs one of each plug, being connected together by a flexible cord conductor and said conductor being connected to one of said two contact-bolts, the other of said two bolts being connected through the telephone, the second-mentioned bolt being connected through the generator and the last-mentioned bolt being connected but not through the telephone or generator by a flexible conductor with one of the other contact-pieces of the plugs, while the remaining contact-piece of the plugs is connected by a flexible conductor with the switch-lever, substantially as set forth.

5. In a telephone-exchange system, a pair of loop-switch plugs, in combination with a switch for said pair of plugs and an operator's telephone, said switch having a lever and two contact-bolts on which said lever may alternately be placed, two contact-pieces of the plugs, one of each plug, being connected together by a flexible cord conductor, the other contact-piece of one of the plugs being connected by a flexible conductor to the lever of the switch, and the other contact-piece of the other plug being connected through the telephone to one of said contact-bolts of the switch and also connected, but not through the telephone, with the other contact-bolt of the switch, substantially as set forth.

6. In a telephone-exchange system, a pair of loop-switch plugs, in combination with a switch for said pair of plugs and an operator's calling-generator, said switch having a lever and two contact-bolts on which said lever may alternately be placed, two contact-pieces of the plugs, one of each plug, being connected together by a flexible cord conductor, the other contact-piece of one of the plugs being connected by a flexible conductor to the lever of the switch, and the other contact-piece of the other plug being connected through the calling-generator to one of said contact-bolts of the switch and also connected, but not through the calling-generator, with the other contact-bolt of the switch, substantially as set forth.

7. In a telephone-exchange system, a pair of loop-switch plugs, and a calling-generator, in combination with a switch for said pair of plugs and an operator's telephone, said switch having a lever and three contact-bolts on which said lever may alternately be placed, two contact-pieces of the plugs, one of each plug, being connected together by a flexible cord conductor, the other contact-piece of one of the plugs being connected by a flexible conductor to the lever of the switch, and the other contact-piece of the other plug being connected through the telephone to one of said contact-bolts of the switch, through the generator with another contact-bolt of the switch, and also connected, but not through the telephone or generator, with the other contact-bolt of the switch, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
B. WASHINGTON MILLER,
C. M. BROOKE.