(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,402. Patented Oct. 26, 1897.

Fig. 1.

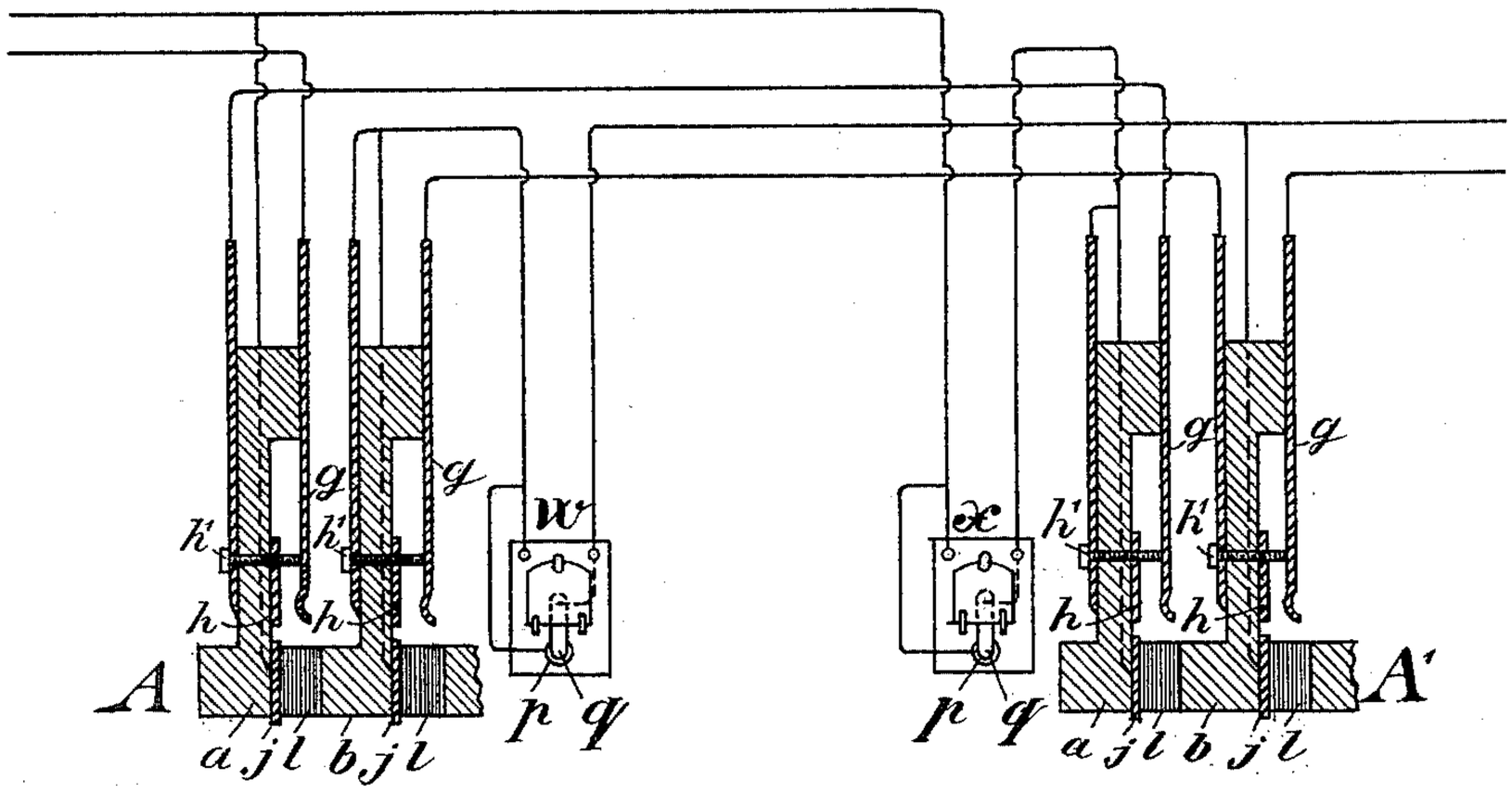


Fig. 2.

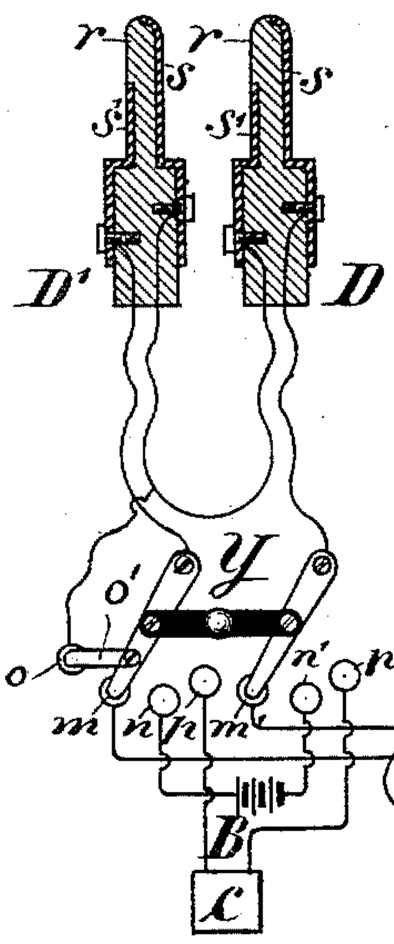


Fig. 3.

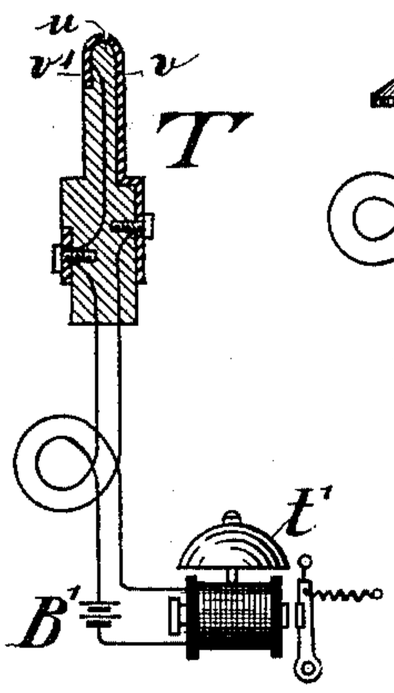
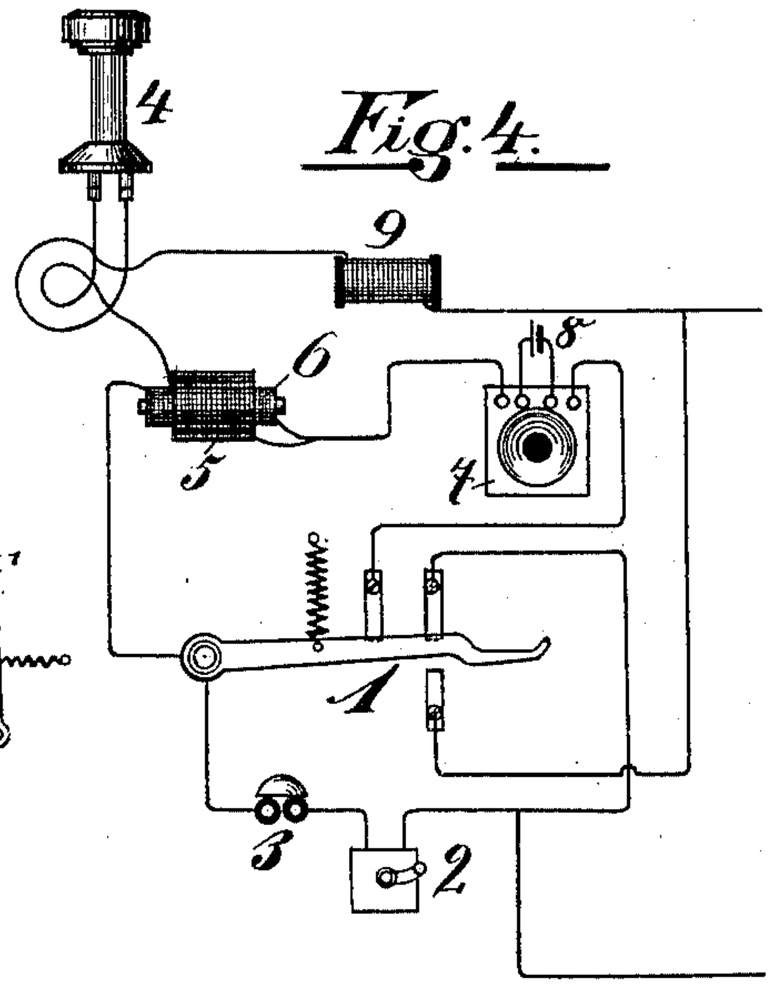


Fig. 4.



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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. 592,402, dated October 26, 1897.

Application filed May 19, 1891. Serial No. 393,273. (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 exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to a telephone-exchange system in which the lines are metallic-circuit lines and in which the necessary switching between the lines is accomplished by means of pairs of 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, and, secondly, of an arrangement of the 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 is a diagram illustrating a subscriber's-station apparatus.

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 connected into the circuit of its line, as will hereinafter be described.

The line-annunciators have each two contact-points which are normally out of contact, but which are pressed into contact by the annunciator-drop when it indicates a call. One of these points is marked *p*, and the other, which is a spring-contact and is actuated by the drop, as described, is marked *q*. One of the contact-points is connected to the circuit in which is the annunciator on one side of the annunciator-magnet and the other point is connected to the circuit on the other side of the magnet.

Two metallic-circuit lines are shown in the figure, 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, and is then connected to the other side or branch of the line (to which the contact-pieces *j j* are connected) after said branch has been connected to all of said contact-pieces. The annunciator of the line is placed in the circuit between the last contact-piece before the two branches are united and the contact-piece immediately preceding the last one, and is located at the same board as said last contact-piece.

The two branches of the line are normally on closed circuit at the subscriber's station and may be provided with any usual and appropriate subscriber's-station apparatus.

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. Y is the looping-in switch for the pair of cords shown. *t* is the operator's telephone, and B is her calling-generator. The looping-in switch has two levers and three pairs of contact-points on which the levers may be alternately placed at the will of the operator. One pair of the contact-points are marked *m m′*, and they are connected by a loop which contains the operator's telephone. The pair adjoining them are marked *n n′*, and they are connected by a loop which contains the operator's calling-generator. The next pair are marked *p p′*, and they are connected by a simple loop. When the levers pass from *m m′* to *p p′*, they rest on *n n′*. The connections are substantially as shown.

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-levers, and *o′* is a contact-point which is connected to one of the levers, as shown, and moves with the lever. The contact-points *o o′* are in contact when the switch-levers are on the contact-points *m m′* and are out of contact when the levers are 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-levers are moved from their normal position.

Only one pair of switch-plugs with their cords and looping-in 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 levers of each looping-in switch normally rest on the contact-points *m m′*.

In the operator's test system shown in Fig. 3, T is the loop test-plug. *t′* is the test receiving instrument, and B′ is a test-battery. *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 connections, as above described. The two contact-pieces *v v′* of the plug are connected by a flexible conducting-loop in which are the test receiving instrument and battery.

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. 4, 1 is a 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 circuit 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, 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, or the resistance of two lines included in the circuit. This adjustment can be regulated as required by the addition of artificial resistance in the circuits. This construction and adjustment depend on the fact that an electromagnet may be readily made so as to operate when a battery and a certain resistance is 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 cord system in connection with the switchboards will be easily understood and I will not describe it in detail.

When the lines are connected together for conversation and the annunciator of one of the lines is in circuit with them for clearing-out purposes, the combined circuit is one of metallic continuity throughout 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 and cause the annunciator to indicate a clearing-out signal. This is accomplished by means of the resistance arrangement, as described, to produce the test system with the marginal system of adjustment connected therewith, as described herein.

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, 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, 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 resistance included in the circuit in which the test receiving instrument and battery are included, said resistance being the normal resistance of the two lines or, if their telephones are switched for use, an increased resistance on account of the extra resistance thereby switched into circuit with the lines. Therefore when the test receiving instrument and battery are looped into closed circuit with a line, the test indication is made by the marginal adjustment of the instrument to the battery and resistances by which the instrument sounds when the comparatively greater current is passing through it when neither the line nor the subscriber's telephone is switched for use, due to the comparatively small resistance of the circuit, and does not sound when the comparatively smaller current is passing through it when either the line or the subscriber's telephone is switched for use, due to the comparatively large resistance of the circuit.

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

The other operations of the system will be easily understood and I will not describe them in detail.

When an operator receives a call from a line, she places one of a pair of her plugs in the switch of the line, and when she connects the line with another line she puts the other plug of the pair in the switch of the other line. The result of these operations, as far as the annunciators are concerned, will be hereinafter described.

In multiple systems heretofore devised the line-annunciators have been placed in the circuit-wire which connects the two branches of the line after one of the branches has passed through all the pairs of its switch con-

tact-points and the other has been connected to the other contact-pieces of its switches on the several boards, and a special clearing-out annunciator has been acquired for each pair of switch-cords. In my system, by the employment of the line-annunciators constructed with contact-points, as described, and the location of the annunciators in their respective circuits, as described, I provide for a single annunciator in the circuit of each two lines connected together for conversation, which is located at the board where the connection between the two lines is made and which will indicate any clearing-out signal sent over the line, and at the same time I dispense with the use and the accompanying expense of special clearing-out annunciators for the several pairs of cords.

In some multiple systems the test indicates to the operator that the line is switched at some board of the exchange. In other systems the test indicates that the subscriber's telephone is switched for use. In my system the test indicates that the line is "busy" whether it is switched at any board or the subscriber has taken his telephone down for use, and the service of the exchange is more satisfactory to the subscribers than in either of the other general systems of testing above indicated.

When an operator connects a line on which a call has been indicated at her board with another line by the insertion of the switch-plugs, as heretofore indicated, and the other line has its calling-annunciator at another board of the exchange, the annunciator of the line in which the call originated is included in the circuit and the annunciator of the other line is not in the circuit. When both annunciators are located at her board, both would be left in the circuit; but she will leave down the drop of one of the annunciators, which shunts the magnet and practically removes it from the circuit. In multiple systems she will be required to do this comparatively but few times. She therefore has at all times one annunciator in the circuit of any two lines connected together and this without the use and expense of special clearing-out annunciators.

In other multiple-switchboard systems two switches have been employed for each line at the board where the line-annunciator was placed, one known as the "answering-switch," and the annunciator placed in the circuit of the line between them. In that case the operator is enabled to leave the annunciator of one line in the circuit and the other out of circuit when he connects two lines together which have their annunciators at her board. This is accomplished by connecting the answering-switch in the circuit of the line farthest of all the switches of the line from the subscriber's station and placing the line-annunciator between the answering-switch and the next preceding switch. This arrangement requires two switches at one of the boards, so that one line-annunciator shall ever be in the circuit of two connected lines. In the system herein described, however, only one line-switch is required for each line on each board. This is accomplished by the arrangement of annunciators and switches and of the annunciator-contacts, as described herein.

I claim as my invention—

1. In a telephone-exchange system, a metallic-circuit line normally or during the time while it is not switched for conversation on closed circuit, in combination with switch apparatus by which the line may be switched in metallic circuit with another line, resistance at the subscriber's station and a switch with contacts to switch a greater resistance into the line-circuit when the telephone is switched for use than the normal resistance, a test receiving instrument and battery in a loop and switch apparatus by which said loop may be looped into the normal circuit of the line, said instrument and battery being so adjusted to each other and the line and the resistances by the marginal adjustment of the instrument to the other parts that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively small resistance, but does not sound when on open circuit or on closed circuit with the line with the additional resistance in the line on the telephone being switched for use or on closed circuit with the line and another line and the comparatively greater resistance being thereby included in the circuit, substantially as set forth.

2. In a telephone-exchange system, multiple switchboards, metallic-circuit lines each normally or during the time while it is not switched for conversation on closed circuit, in combination with switch apparatus by which each line may be switched in metallic circuit with any other line, resistances at the subscriber's station and a switch with contacts to switch a greater resistance into the line-circuit when the telephone is switched for use than the normal resistance, a test receiving instrument and battery in a loop and switch apparatus by which said loop may be looped into the normal circuit of the line, said instrument and battery being so adjusted to each other and the line and the resistances by the marginal adjustment of the instrument to the other parts that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively small resistance but does not sound when on open circuit or on closed circuit with the line with the additional resistance in the line on the telephone being switched for use or on closed circuit with the line and another line and the comparatively greater resistance being thereby included in the circuit, substantially as set forth.

3. In a telephone-exchange system, a metal-

lic-circuit line, one side or branch of which passes through a pair of switch contact-points and thence by an ungrounded connection to the other side or branch of the line, in combination with switch apparatus by which when the two sides of the line are connected through such switch with the two sides or branches of another metallic-circuit line, said pair of contact-points is open, resistances at the subscriber's station and a switch with contacts to switch a greater resistance into the line-circuit when the subscriber's telephone is switched than otherwise, a test receiving instrument and battery in a loop and switch apparatus by which said loop may be looped into the normal circuit of the line, said instrument and battery being so adjusted to each other and the line and the resistances by the marginal adjustment of the instruments to the other parts that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively small resistance but does not sound when on open circuit or on closed circuit with the line with the additional resistance in the line on the telephone being switched for use or on closed circuit with the line and another line and the comparatively greater resistence being thereby included in the circuit, substantially as set forth.

4. In a telephone-exchange system, multiple switchboards, metallic-circuit lines, one side or branch of each of which pass through a pair of switch contact-points and thence by an ungrounded connection to the other side or branch of the line, in combination with switch apparatus by which when the two sides of the line are connected through such switch with the two sides or branches of another metallic-circuit line, said pair of contact-points is open, resistances at the subscriber's station and a switch with contacts to switch a greater resistance into the line-circuit when the subscriber's telephone is switched than otherwise, a test receiving instrument and battery in a loop and switch apparatus by which said loop may be looped into the normal circuit of the line, said instrument and battery being so adjusted to each other and the line and the resistances by the marginal adjustment of the instrument to the other parts that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively small resistance but does not sound when on open circuit or on closed circuit with the line with the additional resistance in the line on the telephone being switched for use or on closed circuit with the line and another line and the comparatively greater resistance being thereby included in the circuit, substantially as set forth.

5. 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 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 each 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 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 the contact-piece of the switch, and loops, one at each board, each containing a test receiving instrument and battery and 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, substantially as set forth.

6. In a telephone-exchange system, multiple switchboards and a metallic-circuit line normally on closed circuit, one side or branch of which passes successively through pairs of the line-switch contact-points on the several boards there being one pair only of said contacts for each line on each board and the other side or branch of which is connected to switch contact-pieces of the line on the several boards, in combination with a line-annunciator in the circuit of the second-mentioned side or branch of the line between the switch contact-piece connected farthest from the subscriber's station and the next preceding contact-piece and located at the board where the first-mentioned contact-piece is located, and a pair of contacts shunting the annunciator-magnet while the annunciator indicates a call, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:

B. WASHINGTON MILLER,

C. M. BROOKE.