(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,383. Patented Oct. 26, 1897.

Fig. 1a

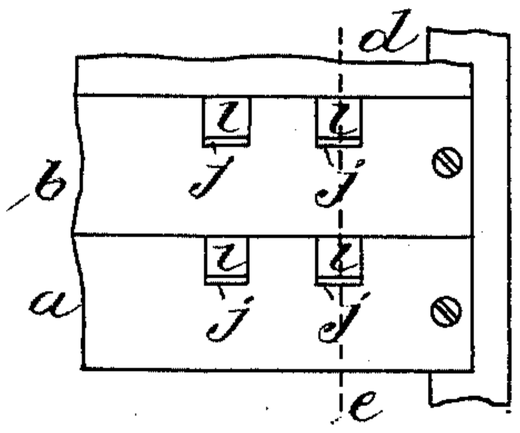


Fig. 1b

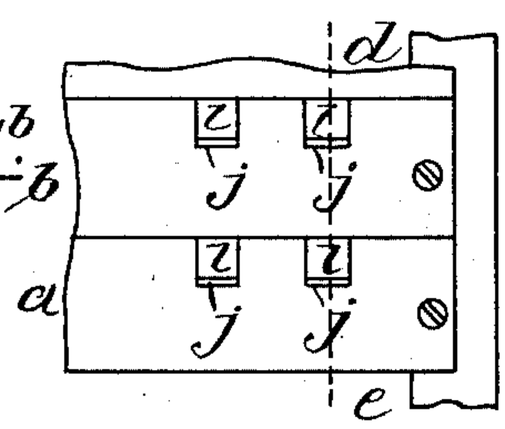


Fig. 2.

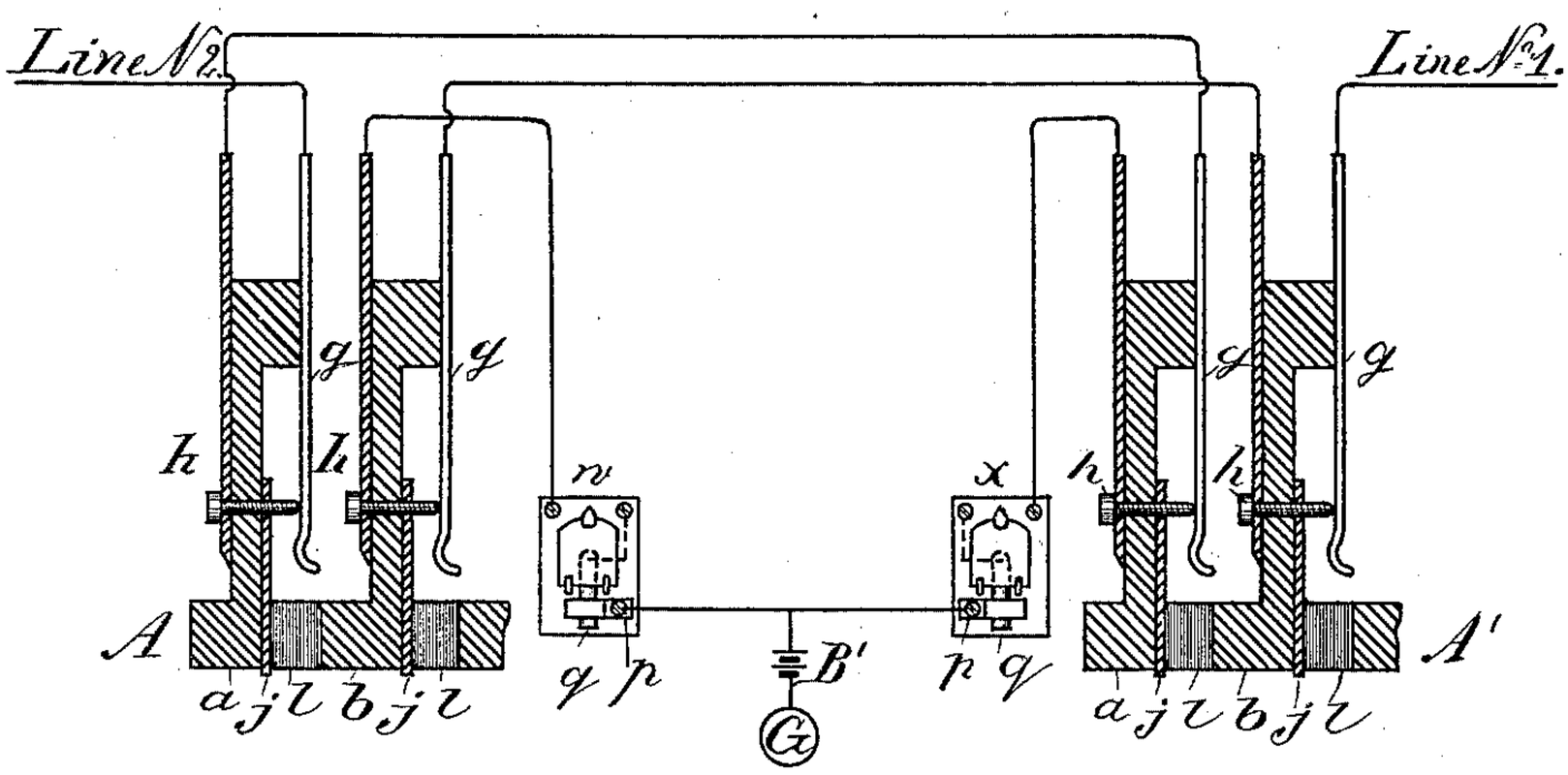


Fig. 3.

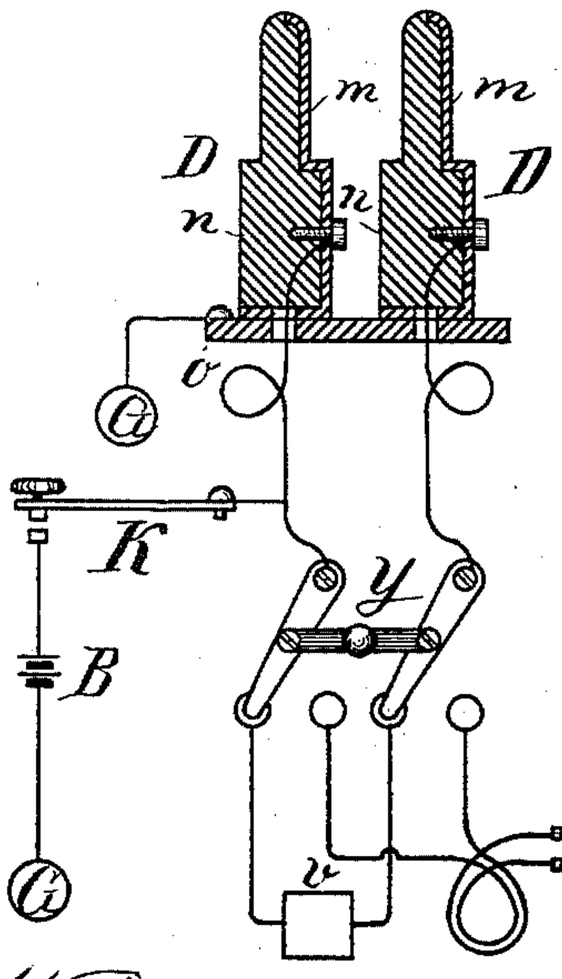


Fig. 4.

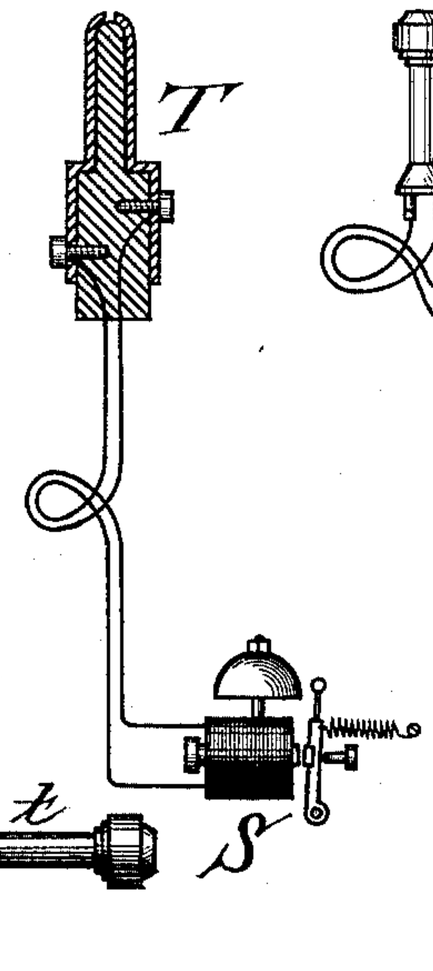
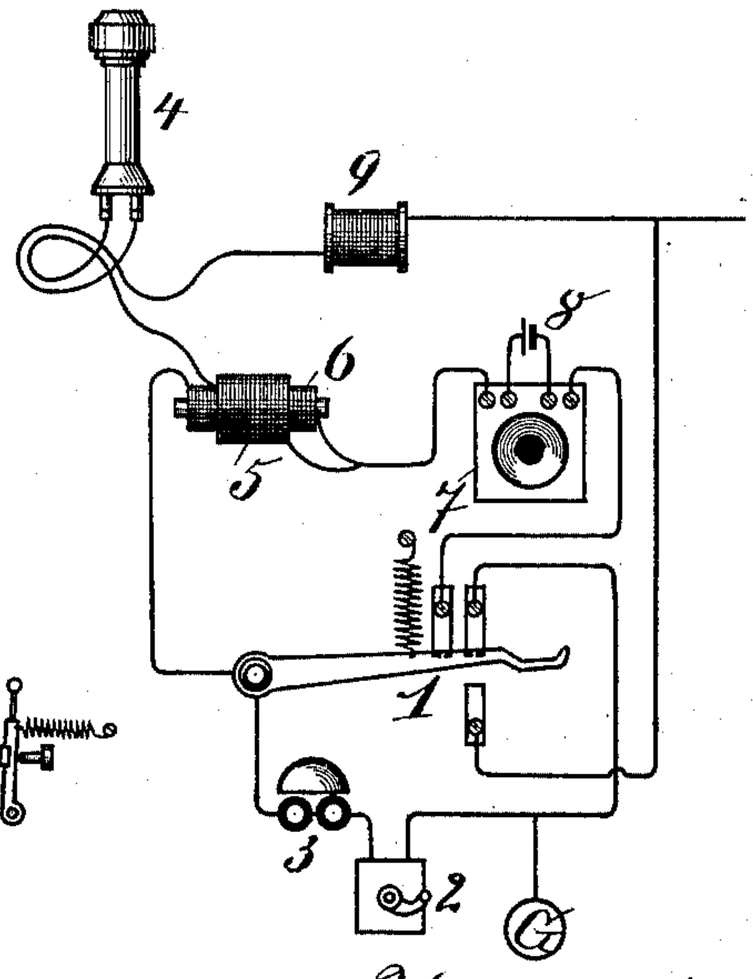


Fig. 5.



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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. 592,383, dated October 26, 1897.

Application filed August 5, 1890. Serial No. 361,110. (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 lines are single-circuit lines grounded at their outer ends and normally grounded at the central office; and it consists in a system of testing the lines to determine whether they are in use.

In the drawings illustrating my invention, Figures 1ª and 1ᵇ 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 an operator's test system to be used at the board. Fig. 5 shows a subscriber's-station apparatus.

In Fig. 2, A is a sectional view of the switchboard shown in Fig. 1ª, and A′ is a sectional view of the switchboard shown in Fig. 1ᵇ, 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 connects with an insulated contact-piece and is adapted to receive a loop-plug and, when a plug is inserted, to disconnect the spring from the contact-piece and connect the two contact-pieces of the plug with the spring and said insulated contact-piece, respectively. The switch is also adapted to receive a single-contact switch-plug and, when a plug is inserted, to disconnect the spring from the contact-piece and connect the spring with the contact-piece of the plug.

In the construction of the switches as shown and as will hereinafter be described I prefer to have a contact-point electrically connected with the contact-piece and on which the spring normally bears, as there is less chance of poor connection when the spring bears on a point than when it bears on a surface adapted to be brought into connection with the plug-contacts.

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 contact-pieces of the switches connected with the points *h h*. *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 along one of the surfaces of the plug-holes as readily to form connection with one of the contact-pieces of the loop-plugs. 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 the contact-piece of the plug are in contact. These holes are also adapted to receive the loop-plug shown in Fig. 4, and when a plug is inserted into a hole it raises the spring of the switch from the contact-point *h*, and the spring *g* and the contact-piece *j* of the switch are in contact with the two contact-pieces of the plug, respectively.

w and *x* are calling-annunciators, one for each of the lines shown. Each annunciator has a pair of contact-points normally (or when the annunciator does not indicate a call) in contact with each other, but which are separated by the annunciator while it indicates a call. The two contact-points of a pair are marked *p* and *q*, respectively. One of them, *q*, is a spring-contact, which is pressed by the annunciator-drop, when the drop falls, away from its corresponding contact-point *p*. The contact-point *p* is represented as an angle-piece, which passes over the spring *q* and is in contact with the spring when the spring is not actuated by the annunciator-drop.

B′ is a test-battery placed in the common ground wire or connection of the lines.

Two lines are shown in the drawings, one marked line No. 1 and the other line No. 2.

These lines are ordinary single-circuit lines grounded at their outer ends and having at the subscribers' stations any usual and appropriate subscriber's-station apparatus. Each line passes successively through the pairs of contacts of its switches on the several boards, passing in each case to the spring first. It then passes through its line-annunciator and the pair of contact-points of the annunciator to the common ground wire or connection in which is the test-battery B'. The circuit of each line shown may thus be traced in Fig. 2.

In the operator's cord system shown in Fig. 3, D D are the switch-plugs of a pair of cords. *n n* are the rubber insulations of the plugs, and *m m* are their contact-pieces. These contact-pieces pass each to the bottom of its plug and are adapted to rest normally, or when the plug is not in use, on the metal piece *o*, which then connects it with the ground. Weights, as is usual, or similar devices may be used to bring the contact-pieces of the plugs into contact with the piece *o* and secure a good connection. These plugs are adapted to be inserted into any of the switches at their board, and when a plug is inserted it operates the switch, as above described. The plugs should be inserted so that the contact-piece *m* is in contact with the spring *g*. The connections of the lines might have been reversed, so that the lines pass first to the contact-piece *j* of each of their switches, and in that case the plugs should be inserted in such a position that their contact-pieces form connection with the pieces *j* of the switches. Y is the looping-in switch for the pair of cords shown. K is the calling-key, and *v* is a clearing-out annunciator. *t* is the operator's telephone, and B is her calling generator or battery. The circuits are substantially as shown.

The operation of the system in connection with the switchboards will be apparent to those skilled in the art.

It will readily be apparent that when a line is switched by the insertion of a plug into its switch the line is disconnected from its normal ground-wire at the central office in which is the test battery B' and is connected into a circuit with the pair of cords. Only one pair of cords is shown, but the connection of such other pairs, with their accompanying apparatus, as the operator may need will be apparent to those skilled in the art. To each pair of cords with its plugs belong a looping-in switch, a clearing-out annunciator, and a calling-key. One telephone and one calling-generator will answer for her system of cords.

In the operator's test system shown in Fig. 4, T is a loop test-plug adapted to be inserted into any of the switches and, when inserted, to operate them as heretofore described, and S is a test receiving instrument. The instrument is connected in a loop which terminates in the two contact-pieces of the plug.

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

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 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 circuts 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. This adjustment can be regulated as required by the addition of artificial resistances in the circuits. This construction and adjustment depend on the fact that an electromagnet may be read-

ily 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 normal 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 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 annunciator does not indicate a call 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 line not being switched the subscriber has sent in a call and the annunciator indicates the call or has taken his telephone from the switch for use, the instrument will not sound, as the line being open at the annunciator-points or 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 office ground—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 line-annunciator indicates a call, and when the instrument does not sound she knows that either the annunciator indicates a call or 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 sends in his call or takes the telephone down for use.

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. Moreover, in this system the line tests "busy" as soon as the calling-generator operates and the annunciator indicates a call whether the subscriber may have taken down his telephone for use or have replaced it on its switch.

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

1. In a telephone-exchange system, a telephone-line normally on closed circuit and containing a test-battery in its circuit, in combination with an annunciator normally in the circuit of the line and having contact-points by which the circuit is open when the annunciator indicates a call, the subscriber's-station apparatus, containing a telephone, a telephone-switch, resistance contacts and circuits by which a greater resistance is switched into the circuit of the line when the telephone is switched for use than when it is not thus switched, a test receiving instrument and switch apparatus for looping the same into such normally closed circuit, said instrument being constructed and adjusted to sound or respond when looped into such circuit and neither the telephone is switched for use nor the annunciator indicates a call and not to respond when either the telephone is switched or the annunciator indicates a call, substantially as set forth.

2. In a telephone-exchange system, telephone-lines normally on closed circuit and each having a test-battery in circuit, in combination with an annunciator normally in the circuit of each line, with contact-points by

which the line-circuit is open when the annunciator indicates a call, a subscriber's-station apparatus for each line, containing a telephone, a telephone-switch, resistance, contacts and connections by which a greater resistance is switched into the circuit of the line when the telephone is switched for use, a test receiving instrument and switch apparatus for looping the same into the normally closed circuit of either line, said instrument being constructed and adjusted to sound when looped into the circuit and neither the subscriber's telephone is switched nor the annunciator indicates a call and not to sound when either the telephone is switched or the annunciator indicates a call, substantially as set forth.

3. In a telephone-exchange system, ground-circuit lines normally on closed circuit and containing a test-battery in their common ground-wire, in combination with an annunciator normally in the circuit of each line, with contacts by which the circuit is open when the annunciator indicates a call, a subscriber's-station apparatus for each line, containing a telephone, a telephone-switch, resistance, contacts and connections by which a greater resistance is switched into the circuit of the line when the telephone is switched for use than when it is not thus switched, a test receiving instrument and switch apparatus for looping the same into the normally closed circuit of any of the lines, said instrument being constructed to sound or respond when looped into the circuit and neither the telephone is switched for use nor the annunciator indicates a call and not to respond when either the telephone is thus switched or the annunciator indicates a call, substantially as set forth.

4. In a telephone-exchange system, a telephone-line normally on closed circuit, in combination with an annunciator normally in the circuit of the line, having contact-points by which the circuit is open when the annunciator indicates a call, the subscriber's-station apparatus, containing a telephone, a telephone-switch, resistance, contacts and circuits by which a greater resistance is switched into the circuit while the telephone is switched for use than while it is not thus switched, a test receiving instrument, switch apparatus for looping the same into the line-circuit and a test-battery in the circuit thereby established, said instrument being constructed to respond or sound when looped into the circuit of the line and the annunciator does not indicate a call or the subscriber's telephone is not switched for use and not to sound or respond when either the annunciator indicates a call or the telephone is thus switched, substantially as set forth.

5. In a telephone-exchange system, telephone-lines grounded at their outer ends and multiple switchboards for the same, each board containing a switch for each line, each switch having a pair of contact-points normally in contact, adapted to receive a switch-plug and when the plug is inserted to have the contact-points separated and the contact-piece of the plug in contact with the line contact-point of the switch, and with that only, and adapted to receive a loop test-plug and when the plug is inserted to have the contact-points separated and connection made between them and the two contact-pieces of the plug, respectively, each line passing successively through the pairs of contact-points of its switches, passing in each case to the line contact-point first, and thence to ground, in combination with an annunciator normally in the circuit of each line, each annunciator having a pair of contact-points by which its line-circuit is open while it indicates a call, a test-battery normally in closed circuit with each line, a subscriber's-station apparatus for each line, containing a telephone, a telephone-switch, resistance, contacts and connections by which greater resistance is included in the line-circuit while the telephone is switched for use than while it is not thus switched, and a test receiving instrument at each board, included in a loop which terminates in the two contact-pieces of a test-plug, each instrument being constructed and adjusted to sound or respond when it is included in the closed circuit of either line and neither the subscriber's telephone is switched for use nor the line-annunciator indicates a call and not to sound when either the telephone is thus switched or the annunciator thus indicates, substantially as set forth.

6. In a telephone-exchange system, telephone-lines grounded at their outer ends and multiple switchboards for the same, each board containing a switch for each line, each switch having a pair of contact-points normally in contact, adapted to receive a switch-plug and when the plug is inserted to have the contact-points separated and the contact-piece of the plug in contact with the line contact-point of the switch and with that only, and adapted to receive a loop test-plug and when the plug is inserted to have the contact-points separated and connection made between them and the two contact-pieces of the plug, respectively, each line passing successively through the pairs of contact-points of its switches, passing in each case to the line contact-point first and from the last switch to the common ground of the lines in which is a test-battery, in combination with an annunciator in the circuit of each line, each annunciator having a pair of contact-points by which its line-circuit is open while it indicates a call, a subscriber's-station apparatus for each line, containing a telephone, a telephone-switch, resistance, contacts and connections by which a greater resistance is included in the circuit of the line while the telephone is switched for use than while it is not thus switched, and a test receiving instrument at

each board, included in a loop which terminates in the two contact-pieces of a test-plug, each instrument being constructed and adjusted to sound or respond when it is included in the closed circuit of either line and neither the subscriber's telephone is switched for use nor the annunciator indicates a call and not to sound when either the telephone is thus switched or the annunciator thus indicates, substantially as set forth.

In witness whereof I hereunto subscribe my name this 23d day of June, 1890.

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,

ABBOTT L. MILLS.