(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,307. Patented Oct. 26, 1897.

Fig. 1.

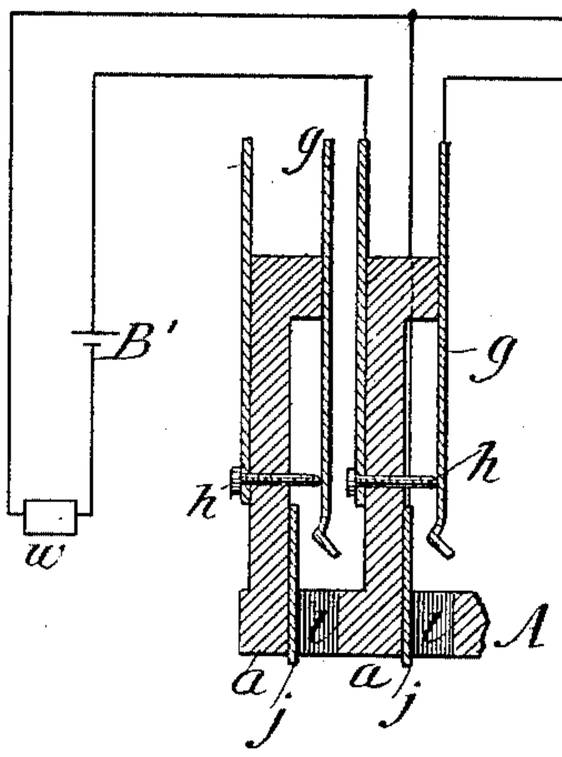


Fig. 2.

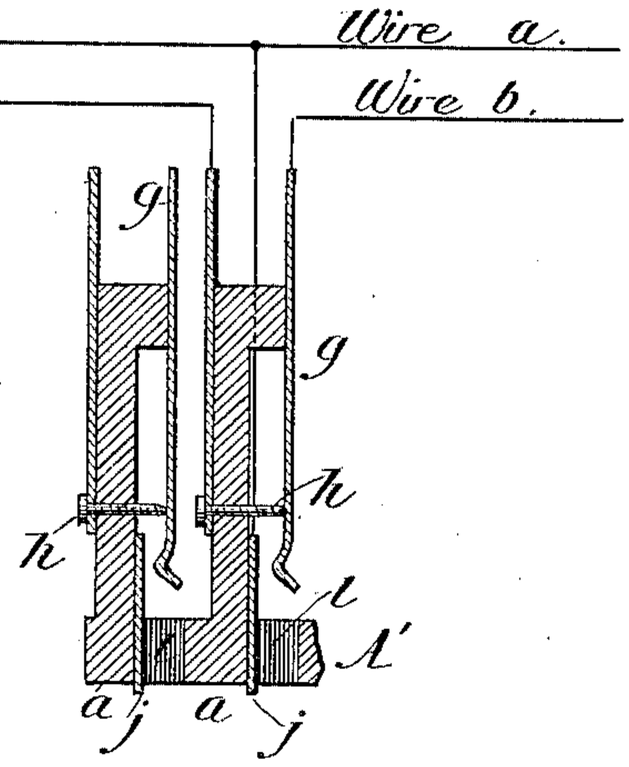


Fig. 3.

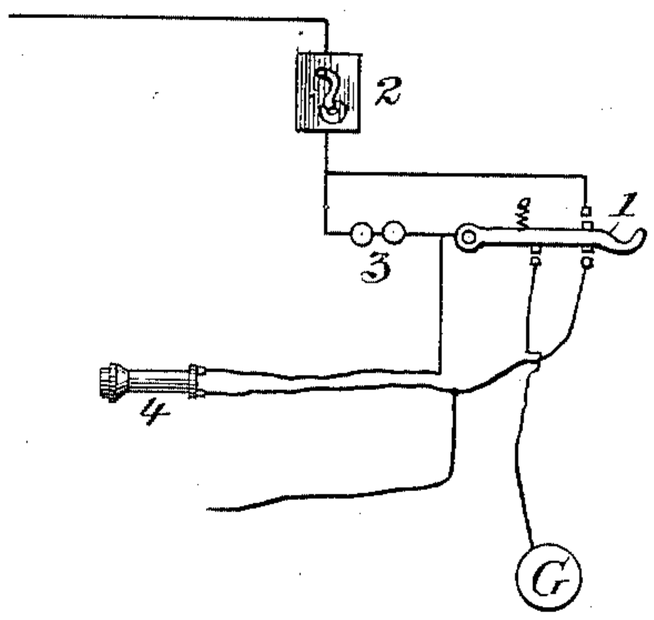
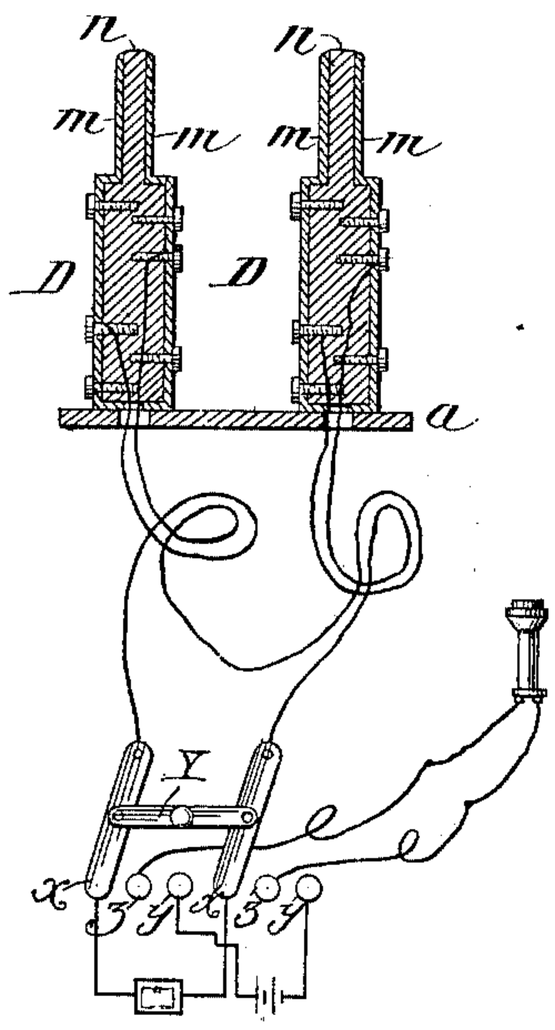
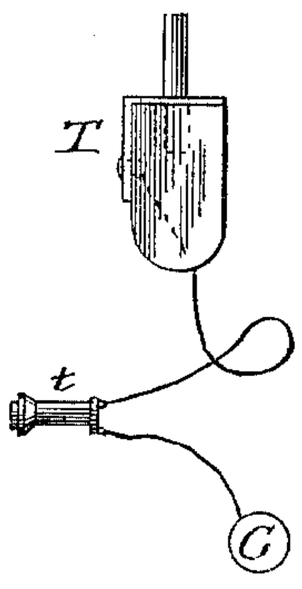


Fig. 4.





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UNITED STATES PATENT OFFICE.

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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,307, dated October 26, 1897.

Application filed March 6, 1888. Serial No. 266,315. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, 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 metallic-circuit telephone; and it consists of apparatus for a system of testing at any board of a multiple exchange system to determine whether a line is in use.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram illustrating the main-line central-office apparatus and circuit connections. Fig. 2 shows a diagram of the subscriber's-station apparatus. Fig. 3 shows a diagram of an operator's cord system for calling and answering, switching, and clearing out subscribers' lines. Fig. 4 shows an operator's test system, including a test-plug with cord, test receiving instrument, and connections.

In Fig. 1, A is a sectional view of one switchboard, and A′ is a sectional view of another switchboard, to which the same lines are connected. I place as many boards in the central office as are found necessary or desirable in order to properly answer the calls and make the necessary connections. On each board is a spring-jack or other suitable switch for each line. Each spring-jack has a contact-spring which normally bears on an insulated contact-point and has a contact-piece insulated from the rest of the switch (except by the line connection) and is adapted to receive a loop-switch plug and, when the 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 the figure, *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 switch. *l l* are the switch-holes.

a a are the rubber strips on which the spring-jack parts are mounted, as shown, and through the fronts of which are the holes *l l*. These holes are adapted to receive the switch-plugs shown in Fig. 3 and marked D D, and when the plugs are inserted in the switches they operate them as above described.

The insulated contact-pieces *j j* should be so placed that a test-plug or other switch testing device may be readily applied to them.

B′ is a test-battery, and *w* is a calling-communicator.

Each subscriber's main-line circuit begins, say, at the central office and passes by a wire, which we will call "wire *a*," to the subscriber's station, through his station apparatus and back to the central office by another wire, which we will call "wire *b*." One of these wires—say wire *a*—is connected to all the insulated contact-pieces *j j* of its switches on the different boards. The other wire passes successively through the pairs of contact-points formed by the spring-levers and their contact-points of its switches on the different boards, passing in each case to the spring-lever first, as shown. This wire after passing from the last contact-point of the switch farthest distant from the subscriber's station is connected by a circuit-wire to wire *a* of the subscriber's circuit. In this circuit-wire thus connecting the two wires, sides, or branches of a metallic-circuit line I place a test-battery. Fig. 1 shows the connections of one line, as described above. All the other lines of the exchange would be connected through their switches and test-battery in the same way. One battery may be used for each line. It should be strong enough to operate the test receiving instruments used through the test-circuits hereinafter described, but it should not be strong enough to operate a calling-annunciator or signal-bell which may be in the circuit.

In the subscriber's-station apparatus shown in Fig. 2 1 is the telephone-switch, 2 is the calling-generator, 3 is the signal-receiving bell, and 4 is the subscriber's telephone. G represents a ground connection. The circuits of the apparatus are substantially as shown. Where the telephone is on the switch, it closes the pair of contact-points shown, one of which is connected with the ground, and thereby grounds the line. When the telephone is off

from the switch, this ground connection is removed. When the telephone is on the switch, it is short-circuited from the circuit of the line and the signal-receiving bell 3 is in the direct circuit of the line, while the short circuit of the telephone is automatically removed by the act of taking the telephone from the switch for use, thus bringing it into the direct and unshunted circuit of the line, so as to receive any signals due to variations of current, whether telephone or otherwise, which may occur in the line-circuit.

Fig. 3 shows an operator's cord system for answering and connecting subscribers' lines, &c., with one set of loop-switch plugs, double flexible cords, looping-in switch, and clearing-out annunciator, and her telephone and calling-generator and circuits. D D are the switch-plugs and are adapted to fit the switch-holes. *m m* are the insulated contact-pieces of the plugs, and *n n* are their rubber insulations. The two contact-pieces of each plug are respectively connected with the two contact-pieces of the other by flexible conductors, one of which includes a loop-switch Y, having two levers that work on pairs of contacts *x x*, *y y*, *z z*. The clearing-out annunciator is connected between the contact-bolts *x x*, the calling-generator between *y y*, and the operator's telephone between *z z*. The plugs D D normally rest upon a metal plate *a*, with which their contact-pieces are in contact.

The operation of the system in connection with a switchboard shown, as well as the method of connecting other pairs of cords and plugs and their special apparatus to the system, will be apparent to those skilled in the art. Only one calling-generator and one operator's telephone are required for all the pairs of plugs that may be used by one operator.

The operator's test system shown in Fig. 4 consists, essentially, of a wire with a test receiving instrument (preferably a receiving-telephone) in its circuit, said wire being grounded at one end and terminating at its other end with a flexible cord with a test-plug attached adapted to be brought into connection with any of the contact-pieces *j j* at her board. In the figure F is the test-plug, *t* is the test receiving instrument, and G is the ground connection.

Each operator should have a cord system and a test system similar to those described above, and they should be so placed and mounted that she can readily perform the operations required of her.

In the operation of the system the subscriber who desires a call operates his calling-generator, thus causing his line-annunciator to indicate a call at the central office, and immediately removes his telephone from its switch and listens therein to hear any signal which may come over his line, as is usual in telephone-exchange operation. The operator at the central office on observing the indication of the line-annunciator places one of her switch-plugs into the switch of the line at her board, the looping-in switch which belongs to the pair of plugs used being in the position so that her telephone is in closed circuit with the cord-conductors. The subscriber then tells the operator with what line he desires connection, and the operator tests the line wanted, as will be hereinafter indicated, in order to determine whether or not it is switched for conversation. If she finds it is not switched for conversation, she places the plug which is the mate to the one used to connect with the line of the calling subscriber into the switch of the line wanted, and moves the looping-in switch so that her calling-generator is looped into the circuit of the two lines, thus ringing the bell of the subscriber wanted. She then moves the looping-in switch so that the clearing-out annunciator is in the circuit of the lines, and the two lines are thus connected together into a closed circuit for conversation, with the clearing-out annunciator in the circuit to receive any clearing-out signal which is sent. When the subscribers are through conversation, either may operate his calling-generator and thereby cause the clearing-out annunciator to indicate a signal. The operator thereupon removes the plugs from the switches of the two lines. By doing so the normal condition of the lines is automatically restored, and the test-battery of each line is automatically and instantly again brought into closed circuit with its line.

It will appear from the description of the circuits and apparatus above made that an electric current generated by the battery in its circuit will continually pass through the circuit of each line when it is not switched for conversation. It will also appear that when a line is switched for conversation by a switch-plug being inserted into one of the line-switches the complete circuit of the line and the battery will be automatically and abruptly broken at the contact-points *g h* of the switch used, and a new complete circuit is established for the line of which that part of the circuit described above in which is the battery forms no part. When a line is switched for conversation, no battery-current, therefore, is passing through its circuit.

It will be understood that each line is grounded at its subscriber's station when it is not in use.

The test-battery is a source of electricity which provides a current of such character that while on closed circuit with its line it produces no sound in a telephone connected in the ordinary way in its line-circuit or in a circuit neighboring to its line-circuit. Other sources or generators of electrical current or currents may be used which accomplish substantially this result.

It is well known that when a magneto-telephone is placed in closed circuit with a battery or when it is taken from such a closed circuit with a battery at the instant of the

change from the condition when no current is passing through the telephone to the condition in which current is passing through it, or again from the condition when current is passing through it to the condition when no current is passing through it, a click or sound is made in the telephone which is audible to any one who is listening at it. It follows, therefore, that when a subscriber on operating his generator to operate his line-annunciator at the central office and immediately takes his magneto-telephone from its switch, as is usually the operation, thereby bringing the same into closed circuit with his line and with the battery which is in circuit with the line at the central office, he will hear a click or sound in his telephone when the operator at the central office places her switch-plug into the switch of the subscriber's line and thereby disconnects the battery from the line-circuit and at the same time connects her telephone into the circuit. The subscriber has therefore in this system an automatic indication or signal when the operator has switched or connected her telephone to his line and can at once speak to the operator and instruct her what connection he desires without waiting for the operator to first speak and inform the subscriber that she is ready to receive his order. This automatic signal to the subscriber thus given expedites the usual operation of telephone-exchange systems. It is also well known that in the old method of operation the subscriber is sometimes uncertain whether it is the voice of the operator who has connected her telephone into the line-circuit and is talking with him or whether it is some extraneous voice due to cross talk or induction which he may hear while listening for the operator to respond to his call and therefore is uncertain whether to answer and hesitates about doing so. With the automatic indication which my system gives to the subscriber this uncertainty and hesitation will not exist and the subscriber will with promptness communicate his wishes to the operator.

It is also well known that a subscriber frequently desires to call up and converse with several other subscribers in quick succession. In the usual practice in these cases the subscriber first obtains the connection with one subscriber's line, and after finishing the conversation with him operates his generator to send the clearing-out signal and then waits for a certain length of time until his judgment or his experience leads him to believe that the operator at the central office has probably disconnected his line from its connection and placed it in condition to receive a new call. It is, however, frequently a matter of uncertainty with the subscriber whether when he sends the second call it operates the clearing-out annunciator, thus repeating the clearing-out signal, or operates his line-annunciator, thus indicating that he desires to give a new order. He is, moreover, uncertain and troubled in not knowing just how long he had better wait from the time when he sent the clearing-out signal to the time when he shall send the second signal which he desires to be for a call. The result is that he either sends the second call too quick after the clearing-out signal was given, thus causing confusion in the operation of the exchange system, or frequently waits longer than is necessary before sending the second signal, thus losing time. In this system, however, the subscriber by placing his telephone to his ear hears a click in his telephone the moment the operator withdraws the plug from the switch, thus placing the line in condition to receive a new call and will at once send in the new call. This click arises from the line-battery being automatically brought into closed circuit with the subscriber's telephone by the operation of withdrawing the plug from the switch and is an automatic indication to the subscriber that his line is in condition to make a new call, which will be indicated at the central office.

When an operator at any board desires to test a line to see whether it is in use, she connects her test-plug to contact-piece *j* at her board of the line, and thereby connects to the line her test receiving instrument grounded at its other end. By so doing she establishes a branch of derived circuit for those portions of the line which are between the subscriber's ground and the test-circuit ground described above and the test receiving instruments in that derived circuit. If the subscriber's telephone is not switched for conversation and the line is not switched for conversation and therefore has an electric current passing through it, part of the current from the battery will pass through the test receiving instrument according to the well-known law of the division of current through derived circuits. The instrument will respond to the current which passes through it and the operator will hear the click in her telephone. If, on the other hand, the line which is tested has the subscriber's telephone switched for use by being removed from its switch or is switched, no current will pass through the test receiving instrument and no click or sound will be made in the test receiving instrument. Hearing nothing on making the test she will know that the line is in use. When she hears the click, on testing she will know that the line is not in use. When the test is made and the test receiving instrument responds, it indicates in this system both that the line is not switched at the central office and that the subscriber's telephone is on its switch, and when the instrument does not respond it indicates that either the line is switched at the central office or that the subscriber's telephone is off from the switch.

In multiple-switchboard systems an operator to whom certain lines are assigned to answer frequently receives several annunciator-calls at practically the same moment,

and it may require some time before she can switch to a certain line and answer the call. In systems in which the test depends only on the switching of the line at some other 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. In my system this trouble is obviated, because as soon as the subscriber takes the 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 occurs from the fact that a subscriber places his telephone on its switch when he is through conversation without sending a clearing-out signal, and his line tests free and is "connected to" when it is already switched at the central office with another line. In my system this trouble again is obviated 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 both the general systems of testing outlined above.

The battery in the circuit of a line, as described above, should be so adjusted to the apparatus and circuits that it will not operate any signal bells or annunciators which may be in circuit with it. It should, however, be strong enough to operate the test receiving instruments used through the test-circuits described.

The individual batteries, one for each line, normally in the circuit of the lines being a source of constant rather than of pulsatory or intermittent current furnish the test indications and the signals which have heretofore been indicated and at the same time do not furnish sudden variations of current which may cause inductive disturbances in neighboring circuits.

Instead of batteries used as above any constantly-operative sources of electricity may be employed which, when connected and operated in the circuit as described, will give a signal indication to the subscriber and a test indication to the operator.

I claim as my invention—

1. In a telephone-exchange system, metallic-circuit lines, each line normally or while it is not switched for conversation at the central office on closed circuit there, and batteries, one for each line at the central office, normally in the line-circuit, in combination with switching apparatus at the central office to switch any line for conversation and by the act of switching and as long as the line is thus switched removing the battery from its circuit, and a telephone at each subscriber's station at the will of the subscriber in closed circuit with his line, whereby the subscriber may determine when the line is switched for use, substantially as set forth.

2. In a telephone-exchange system, metallic-circuit lines, each line normally or while it is not switched for conversation at the central office on closed circuit there, and sources of electricity, one for each line at the central office, normally in the line-circuit, in combination with switching apparatus at the central office to switch any line for conversation and by the act of switching and as long as the line is thus switched removing the source of electricity from its circuit, and a telephone at each subscriber's station at the will of the subscriber in closed circuit with his line, whereby the subscriber may determine when the line is switched for use, substantially as set forth.

3. In a telephone-exchange system, telephone-lines, each line normally or while it is not switched for conversation at the central office on closed circuit there, and batteries, one for each line at the central office, normally in the line-circuit, in combination with switching apparatus at the central office to switch any line for conversation and by the act of switching, and as long as the line is thus switched removing the battery from its circuit, and a telephone at each subscriber's station at the will of the subscriber in closed circuit with his line, whereby the subscriber may determine when the line is switched for use, substantially as set forth.

4. In a telephone-exchange system, telephone-lines, each line normally or while it is not switched for conversation, at the central office on closed circuit there, and sources of electricity, one for each line at the central office, normally in the line-circuit, in combination with switching apparatus at the central office to switch any line for conversation and by the act of switching and as long as the line is thus switched, removing the source of electricity from its circuit, and a telephone at each subscriber's station at the will of the subscriber in closed circuit with his line whereby the subscriber may determine when the line is switched for use, substantially as set forth.

5. In a multiple telephone-exchange system, metallic-circuit lines, each line normally grounded at the subscriber's station and on closed circuit at the central office, and batteries one for each line at the central office, each normally or while the line is not switched for conversation at the central office in the circuit of its line there but switched from its said circuit by the act of switching and as long as the line is switched for conversation there, in combination with a telephone at each subscriber's station, a switch with contacts and circuit connections switching the telephone at the will of the subscriber into the circuit of his line, and opening the normal ground connection of the line at the subscriber's station while the telephone is switched

into its line-circuit, and a test receiving instrument at the central office grounded on one side and connected on its other side to a plug adapted to be brought into connection with any line whereby the operator may determine whether, and the subscriber may determine when, the line is switched for use, substantially as set forth.

6. In a multiple telephone-exchange system, metallic-circuit lines, each line normally grounded at the subscriber's station and on closed circuit at the central office, and sources of electricity, one for each line at the central office, each normally or while the line is not switched for conversation at the central office in the circuit of its line there but switched from said circuit by the act of switching and as long as the line is switched for conversation there, in combination with a telephone at each subscriber's station, a switch with contacts and circuit connections switching the telephone at the will of the subscriber into the circuit of his line, and opening the normal ground connection of the line at the subscriber's station while the telephone is switched into its line-circuit, and a test receiving instrument at the central office grounded on one side and connected on its other side to a plug adapted to be brought into connection with any line, whereby the operator may determine whether, and the subscriber may determine when, the line is switched for use, substantially as set forth.

7. In a multiple telephone-exchange system, telephone-lines, each line normally grounded at the subscriber's station and on closed circuit at the central office, and batteries, one for each line at the central office, each normally or while the line is not switched for conversation at the central office in the circuit of its line there but switched from its said circuit by the act of switching and as long as the line is switched for conversation there, in combination with a telephone at each subscriber's station, a switch with contacts and circuit connections switching the telephone at the will of the subscriber into the circuit of his line, and opening the normal ground connection of the line at the subscriber's station while the telephone is switched into its line-circuit, and a test receiving instrument at the central office grounded on one side and connected on its other side to a plug adapted to be brought into connection with any line, whereby the operator may determine whether, and the subscriber may determine when, the line is switched for use, substantially as set forth.

8. In a multiple telephone-exchange system, telephone-lines, each line normally grounded at the subscriber's station and on closed circuit at the central office, and sources of electricity, one for each line at the central office, each normally or while the line is not switched for conversation at the central office in the circuit of its line there but switched from its said circuit by the act of switching and as long as the line is switched for conversation there, in combination with a telephone at each subscriber's station, a switch with contacts and circuit connections switching the telephone at the will of the subscriber into the circuit of his line, and opening the normal ground connection of the line at the subscriber's station while the telephone is switched into its line-circuit, and a test receiving instrument at the central office grounded on one side and connected on its other side to a plug adapted to be brought into connection with any line, whereby the operator may determine whether, and the subscriber may determine when, the line is switched for use, substantially as set forth.

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