No. 646,697. Patented Apr. 3, 1900.

W. D. GHARKY.

TELEPHONE EXCHANGE SYSTEM.

(Application filed May 17, 1899.)

(No Model.) 2 Sheets—Sheet 1.

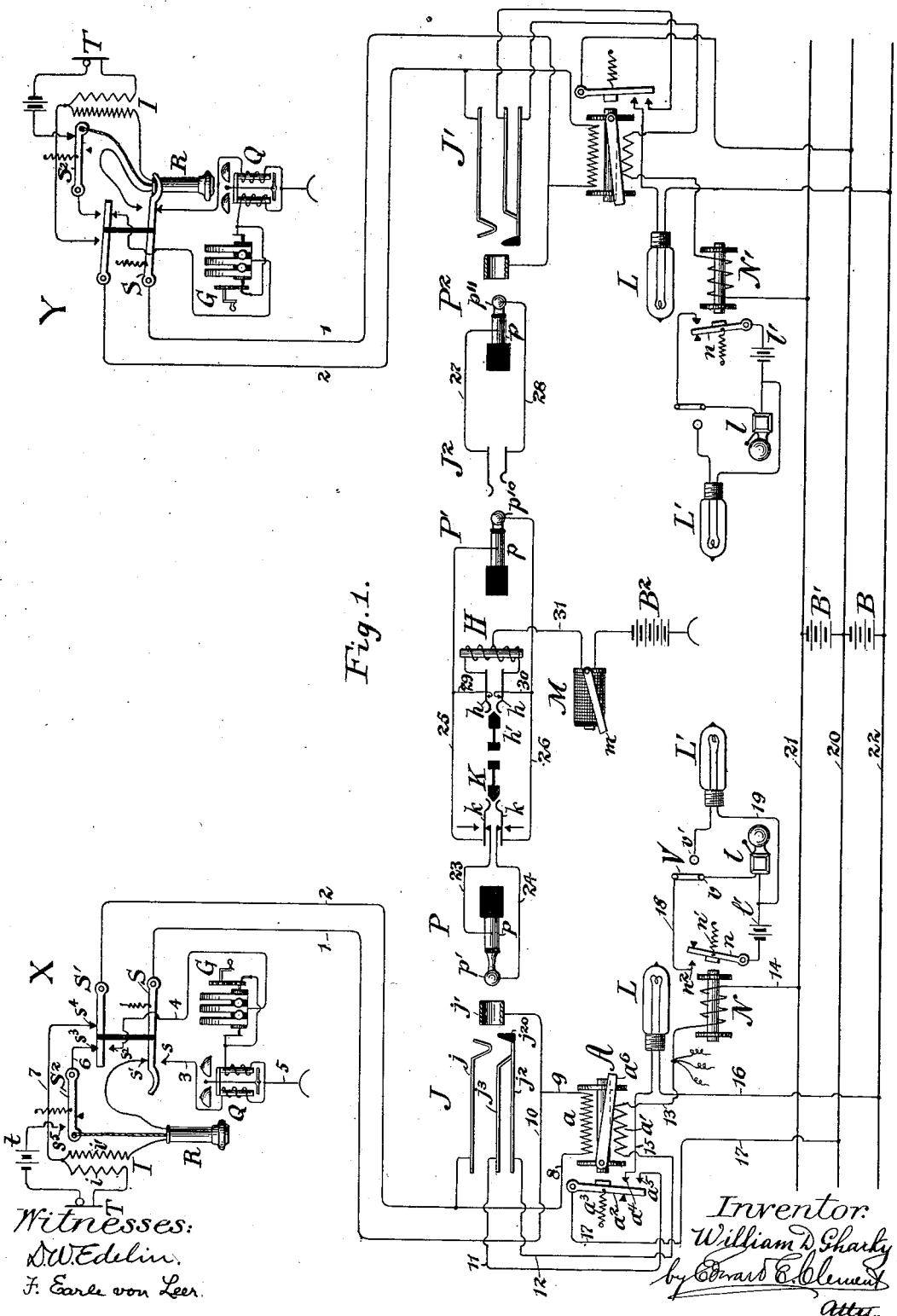

Fig. 1.

Witnesses:
D. W. Edelin.
F. Earle von Leer.

Inventor:
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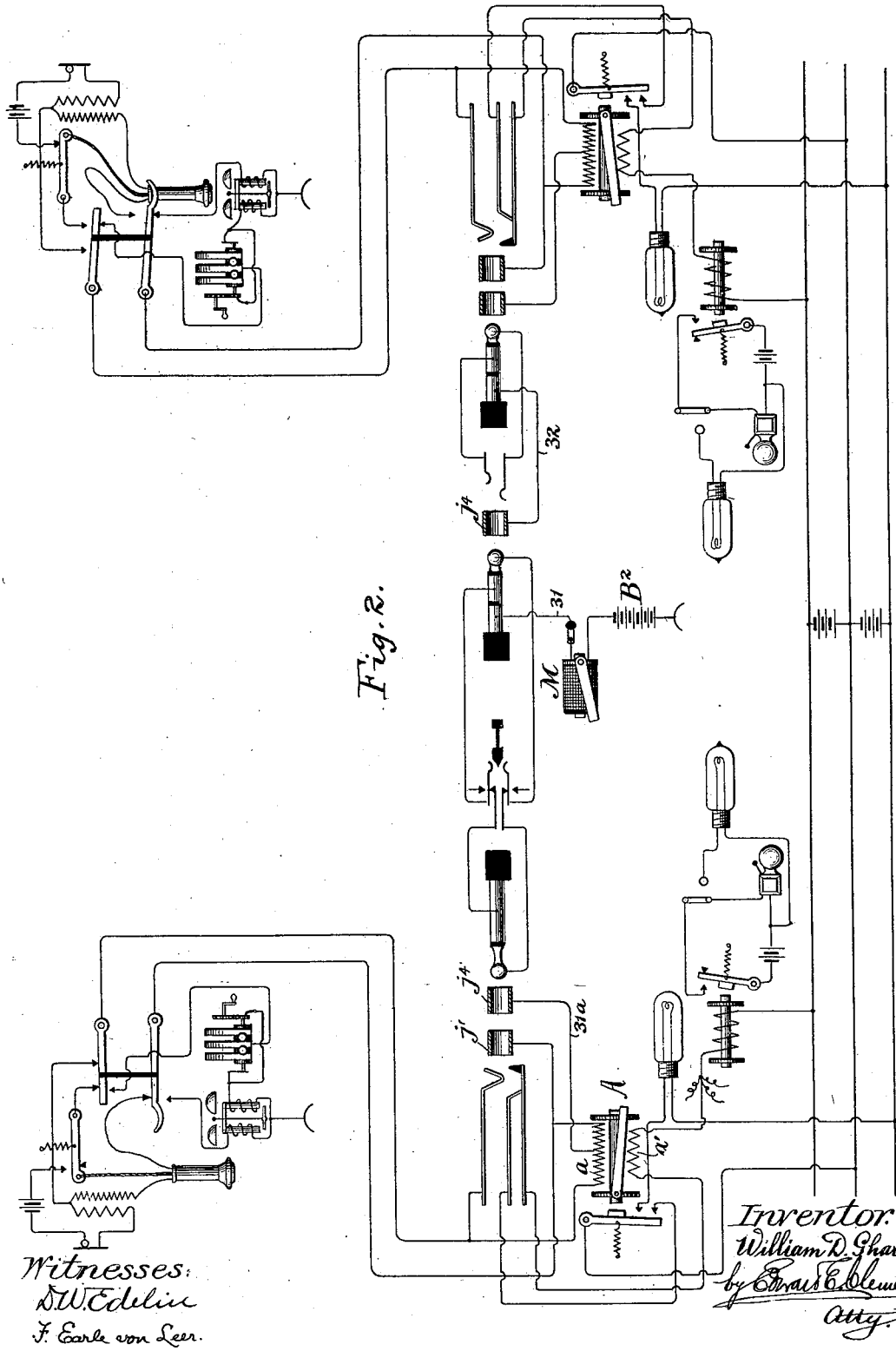

Fig. 2.

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UNITED STATES PATENT OFFICE.

WILLIAM D. GHARKY, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO THE SUN ELECTRIC MANUFACTURING COMPANY, OF NEW JERSEY.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 646,697, dated April 3, 1900.

Application filed May 17, 1899. Serial No. 717,155. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM D. GHARKY, a citizen of the United States, residing in Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof, in which the same letters and figures of reference point out the same parts throughout.

My invention relates to telephone-exchange systems, and has particular reference to systems in which each subscriber has but a single terminal device, located upon a particular section of the switchboard. Connections between subscribers whose terminals are located upon different switchboard-sections are effected through the agency of trunk or transfer lines.

My invention has for one object the provision of means whereby a signal at the central office may be actuated to remain permanently displayed, and yet be self-restoring upon the mere breaking of the circuit by the insertion of a plug, without constant current being supplied to the lines. In other words, it contemplates the permissible use of self-restoring central-energy automatic signals with lines having the ordinary generator for calling.

A further object of my invention is the provision of an improved supervisory signal.

In order to attain my objects, I provide, in the first place, a relay-magnet for each line, which may also control a display-drop whose contacts are in the circuit of a lamp-signal and also include controlling-contacts in the spring-jack. The magnet has double windings, one winding being to line and the other winding being included in certain local circuits which become active upon the energization of the magnet and are thereafter under the control of the operator in answering a call. My supervisory signal I locate in a grounded bridge of the cord-circuit, the ground, however, being entirely removed from the connected lines during conversation.

In the accompanying drawings, Figure 1 is a diagrammatic representation of a central station containing circuits embodying my invention together with two substations connected therewith. Fig. 2 is a similar representation of a somewhat-modified system.

Referring to Fig. 1, X is one subscriber's station and Y another, each connected with the central station by line-wires 1 2. The apparatus of both stations consists of the same elements, which are lettered alike, so that the description of station X will apply to both. At said station I provide the usual transmitter T, receiver R, induction I, hook-switch S, generator G, ringer Q, and local battery *t*. The hook-switch S has a parallel member S' connected to it by an insulated part, both members being pivoted so that they travel together under the weight of the receiver in one direction and by means of a suitable spring in the other direction. The two switch members S S' are connected to the line-wires 1 and 2, respectively, and when the receiver is upon the hook they serve, by resting upon contacts s s^2, to prolong the line-wires through local circuits 3 4 to the generator G and the ringer Q, the middle point of the windings of the latter being connected to ground through a wire 5. The transmitter T is connected in the usual local circuit together with the primary winding *i* of the induction-coil I and the local battery *t*, the continuity of such circuit being controlled primarily by the switch S' through the contacts s^3 s^4. In addition to this control, however, I employ a gravity-switch S^2, whose function will be explained in connection with the central-office apparatus and the use of which is fully set forth in my prior patent, No. 620,440, issued February 28, 1899. The switch S^2 coöperates with the contact s^5 to make or break the local circuit without affecting the line-circuits.

At the central station the line-wires 1 and 2 are connected to contacts *j'* and *j* in the spring-jack J, the former being shown as a collar or thimble in the forward part of the jack and the latter as a spring therein. Bridged across the line-wires just outside of the jack is the winding *a*, preferably of fine wire and high resistance, of the annunciator A, the bridge connection being made by wires 8 and 9. This annunciator-magnet is provided with a second winding *a'*, preferably of few turns and low resistance, and connected

from one extremity through wire 12 to another spring j^2 in the jack, which normally rests, as shown, against the extremity of a twin spring j^3, which is connected by wire 11 to a contact a^5, adapted to coöperate with armature a^2 of magnet A, the armature in turn being connected by wire 17 to bus-bar 20 of the main central-station apparatus. Said armature is adapted to be attracted when either of the coils a or a' is receiving current, and when so attracted it not only closes upon contact a^5 but upon a second contact a^4, connected by wire 15 to lamp L and thence by wire 16 to another bus-bar 22. The armature a^2 is fitted with the usual retracting-spring a^3. The second extremity of the winding a' is connected by wire 13 to the winding of the magnet N, and thence by wire 14 to a third bus-bar 21. The magnet N is provided with an armature n, having a retracting-spring n' and playing between front and back stops, the front stop n^2 constituting a contact-terminal for circuit 18, which includes the bell l, the battery l', and switch V. This circuit is completed through the bell only when the switch is in the position shown, resting upon its contact v. The second contact v', however, is provided, upon which the switch may be thrown to cut out the bell and cut in a branch circuit 19, containing a lamp-signal L'.

I have shown the annunciator A as provided with a signal-armature a^6 in addition to the relay-armature a^2. This signal-armature may be omitted, however, without changing the operation.

It will be understood that the apparatus thus far described is duplicated with the exception of the magnet N and the parts that it controls for every line. The magnet N may be a common relay. It only remains, therefore, to describe the office-connecting circuits and the operation of the whole.

For interconnecting the lines at the central station I provide pairs of plugs P and P', having their sleeve and tip contacts respectively connected together by cord conductors 23 24 and 25 26. Interposed in each cord conductor is a ringing-key K, having springs k, normally maintaining the continuity of the cord-circuit, but adapted to be spread when the push-button of the key is depressed to disconnect the conductors 25 26 from 23 24 and to connect them to a suitable generator-circuit. In each cord-circuit across the conductors 25 26 I provide a normally-complete bridge 29 30, which includes springs h h of a normally-closed switch having a push-button h' to open it and the winding of an impedance-coil H, from the middle point of which a conductor 31 is led to a magnet M and thence to battery B^2 and ground. The magnet M is provided with a signal-armature m.

The plugs P P', it will be observed, are not similar in their configuration. The plug P has its tip p' constructed with a thin or annularly-recessed neck, while the plug P' has a short thick neck for its tip. The reason for this difference in the formation of the tips will be apparent upon reading the operation. It is sufficient to say at this point that when the plug P is inserted in a spring-jack its tip will impinge upon a depressed and insulated projection j^{20} upon the extremity of the spring j^2 and cause the latter to leave its twin spring, thereby breaking the circuit 11 12. After the plug P is fully inserted in a spring-jack, however, the projection j^{20} will rest within the annular recess around the tip, and thereby permit the springs j^2 j^3 again to come together. With the plug P' on the other end or, indeed, P^2, which is a trunk-plug connected by conductors 27 28 to the trunk-jack J^2, no such effect will be produced, the projection j^{20} in such case being held down and the springs consequently separated as long as the plug is in the jack.

The operation of my system thus described is as follows: Assuming that subscriber X desires to converse with subscriber Y, he operates his generator G while his receiver is still upon the hook. The current produced passes over the line-wire and through the winding a of the annunciator-magnet. This energizes the core, which attracts the armature a^2 and also the signal-armature a^6, if the latter is used. The following circuit is then immediately closed: from bus-bar 21, forming the terminal of battery B', through wire 14 to magnet N, through wire 13 to winding a' on magnet A, through wire 12, spring j^2, spring j^3, and wire 11 to contact-point a^5, through armature a^2, and by wire 17 to the bus-bar 20, forming the other terminal of battery B'. At the same time another circuit is closed as follows: from bus-bar 22, forming a terminal for battery B, by wire 16 to lamp L, by wire 15 to contact-point a^4, through armature a^2, and by wire 17 back to bus-bar 20, forming the other terminal for the battery. The closing of the circuit first traced energizes the magnet N and also causes the winding a' to reinforce the winding a in its effect upon the core of the magnet A. Moreover, when the subscriber has ceased operating his generator the current flowing through winding a' will sufficiently magnetize the core of magnet A to keep the armature a^2 attracted. The line-lamp L will therefore continue to glow or the armature a^6 to be visible, or both, after the generator-current has ceased, while as the magnet N has attracted its armature n the bell l or the lamp L' (this being a pilot-lamp for the switchboard-section) will continue to receive current from the battery l' as long as the circuits remain undisturbed. The operator, perceiving the pilot-lamp and the line-signal, inserts the answering-plug P into the jack J. The tip of the plug in passing over the projection j^{20} depresses the same, separating for the moment the springs j^2 and j^3. This breaks the circuit from battery B' through the winding a', and the magnet A, as well as the magnet N, being thereby deën-

ergized the armatures a^2 and n and also the armature a^6 are immediately retracted. The lamps L L′ thereupon become dark and remain so. As the plug is fully inserted into the jack the projection j^{20} passes upward into the annular depression in its tip, and thenceforth during the connection the springs j^2 and j^3 remain in contact. The operator then receives from the subscriber the number of the line wanted. In doing this she employs listening-in devices of the usual or of any desired type. (Not shown in the drawings.) Finding that the subscriber's line wanted terminates upon another board, she inserts the calling-plug P′ into the jack J^2 of a trunk-line leading to the desired board and communicates the number wanted to the operator there stationed over an order-circuit of the usual kind. (Also not shown.) The trunk-operator then picks up the plug P^2 and inserts it in the desired jack J′. As soon as she has done so a circuit will be completed from battery B^2, through magnet M, to and through the impedance-coil H by conductors 29 30 and 25 26 to the plug P′ by trunk-conductors 27 28, plug P^2, jack J′, and the line-wires 1 2 to subscriber's station Y, and thence by the conductors 3 and 4, the windings of the ringer Q in parallel, and wire 5 to ground and back to the battery. Current from battery B^2 flowing in this circuit energizes the magnet M, which causes the display of its signal m, thus indicating to the answering operator that the connection is complete, whereupon she depresses the ringing-key K to send calling-current out over the line to station Y. It will be observed that current cannot flow back from the battery B^2 to the subscriber's station X for the reason that as soon as that subscriber has called he has removed his receiver from the hook, allowing the switch S S′ to rise, thus cutting off the ground 5. The signal m remains displayed until subscriber Y answers the call by removing his receiver from the hook. This breaks his ground-circuit, whereupon the retirement of signal m apprises the answering operator of his response and she depresses the key h' to separate the springs h and cut off the impedance-coil and ground branch from the united circuits, thus leaving no grounds upon the circuit in any part.

The trunk-plug P^2 has its tip p^{11} formed with a short neck, similar to that of the plug P′. Consequently when either of these plugs is inserted in the jack of a wanted line the springs j^2 and j^3 will be kept separated as long as the plug is in the jack. The condition of the signals then during the connection is that the circuits of the magnet A of the calling-line are completed and ready to respond to generator-current at the close of the conversation, while the magnet A of the called line, with all its dependencies, is disabled for all except momentary signals. Clearing-out signals are therefore received by the answering operator only and by her communicated to the trunk-operator over the order-circuit or in any other desired manner. While this is, however, the preferred method of operating this system, because of the localization of responsibility it attains, I do not wish to limit myself, as obviously all the plugs might well be formed, like the plug P, with long thin necks, so that all the line-signals would be capable of responding as clearing-out signals. Supposing that clearing-out current has been sent over the line from both stations to again energize the magnet A and light the lamps L and L′, it should be observed that the mere withdrawal of the plug P from the jack will again serve to separate the springs j^2 and j^3 and restore all the parts to normal.

In Fig. 2 I have shown a modified form of my invention, wherein the impedance-coil H is done away with and the calling-plugs have three contacts instead of two, the third contact being connected by wire 31 to magnet M and battery B^2. Each jack is provided with a third contact j^4 to coöperate with a third contact on each plug, a connection being thence made by wire 31^a to the middle point of the line-winding a on the magnet A. Inasmuch as this winding is permanently bridged across its metallic circuit it obviously takes the place of the impedance-coil. Connection is made from the calling-plugs through the trunk-lines when trunking is necessary by an extra sleeve j^4 in the trunk-jack and a wire 32, leading to the third contact on the trunk-plug.

If during the conversation either subscriber desires to leave his instrument, he allows the same to hang by a suitable cord connecting it with the switch S^2. The use of this switch in the present system is rather important, for if the subscriber X should become tired of waiting and temporarily leave the instrument if he replaced the receiver R upon the hook he would immediately furnish a new ground path for current from battery B^2, and thereby confuse the signal. On the other hand, if he is instructed never to hang up his receiver after once calling until he receives the response he may leave it off the hook for an indefinite time and so exhaust the local battery.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In a telephone-exchange system, a subscriber's line, a switching-terminal therefor, a line-signal having its windings connected to the line and also to a local circuit containing a source of current, said local circuit adapted to be closed when the line-signal magnet is energized, and means made operative upon switching the line for conversation, to momentarily break the local circuit, and permit the retraction of the signal, and thereafter to again render the circuit intact, whereby the signal may act as a clearing-out signal at the close of the conversation, substantially as described.

2. In a telephone-exchange system, a subscriber's station, and a central station, and a

circuit connecting the two and terminating in a spring-jack at the latter; a line-signal magnet having an energizing-winding connected to the line, and another energizing-winding forming part of a local circuit in which is included a source of current, an armature for said signal-magnet adapted to complete said local circuit when attracted, and means made operative by the insertion of a switch-plug in the line-jack to momentarily break said local circuit and permit the retraction of the armature and thereafter to close the break, substantially as described.

3. In a telephone-exchange system, a subscriber's station, a central station, and a circuit interconnecting the two and terminating at a spring-jack at the latter; a line-signal magnet having two windings, one permanently connected to the line, and the other included in a local circuit containing a source of current, an armature for the signal-magnet adapted to close said local circuit when it is attracted, and a circuit-breaker operated in making connection with the line to momentarily break said local circuit and thereafter restore the same, substantially as described.

4. In a telephone-exchange system, a subscriber's station, a central station, and a circuit interconnecting the two and terminating in a spring-jack at the latter station, a signal-magnet having two windings, one winding connected to line, and the other in a local circuit with a source of current; an armature and a contact therefor, for the signal-magnet, constituting normally-open terminals included in the local circuit, and contact-springs in the spring-jack constituting normally-closed terminals in said local circuit, and a switch-plug, together with means actuated by said plug for momentarily separating said springs, when it is inserted in the jack, but thereafter permitting them to come together again, substantially as described.

5. In a telephone-exchange system, a subscriber's station, a central station and a circuit interconnecting the two and terminating in connective means at the latter, a line-signal magnet having one winding connected permanently to line, and a second winding included, together with a local alarm or pilot-signal, in a local circuit closed when the line-winding receives current, and means for breaking said local circuit upon making connection with the line, substantially as described.

In testimony whereof I have hereunto set my hand, in the presence of two witnesses, this 16th day of May, A. D. 1899.

WILLIAM D. GHARKY.

Witnesses:
F. EARLE VON LEER,
ELBERT WILLIAMSON.