

(No Model.)

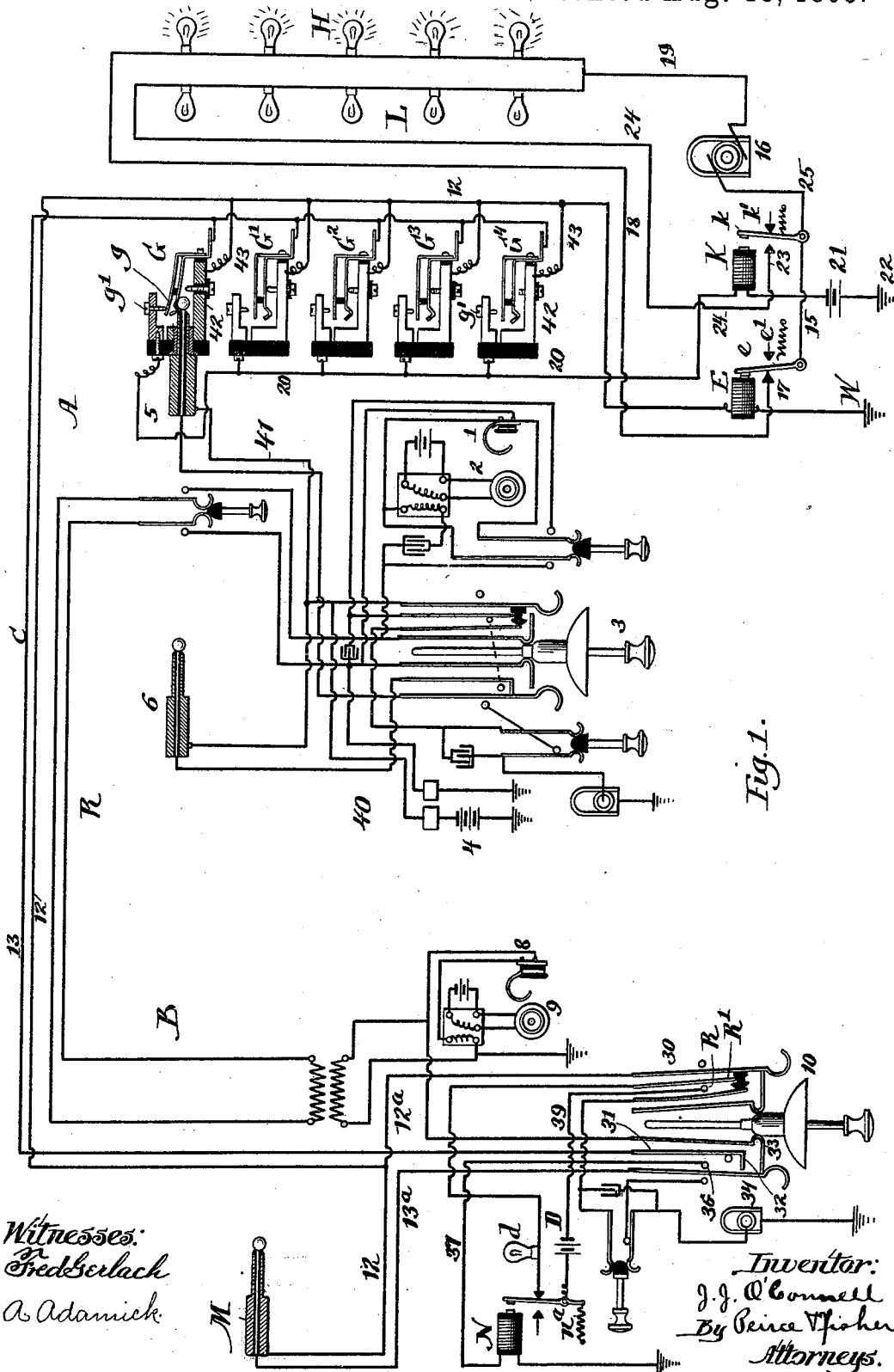
2 Sheets—Sheet 1.

J. J. O'CONNELL.

SIGNAL APPARATUS FOR TELEPHONE EXCHANGES.

No. 544,545.

Patented Aug. 13, 1895.



Witnesses:
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(No Model.)

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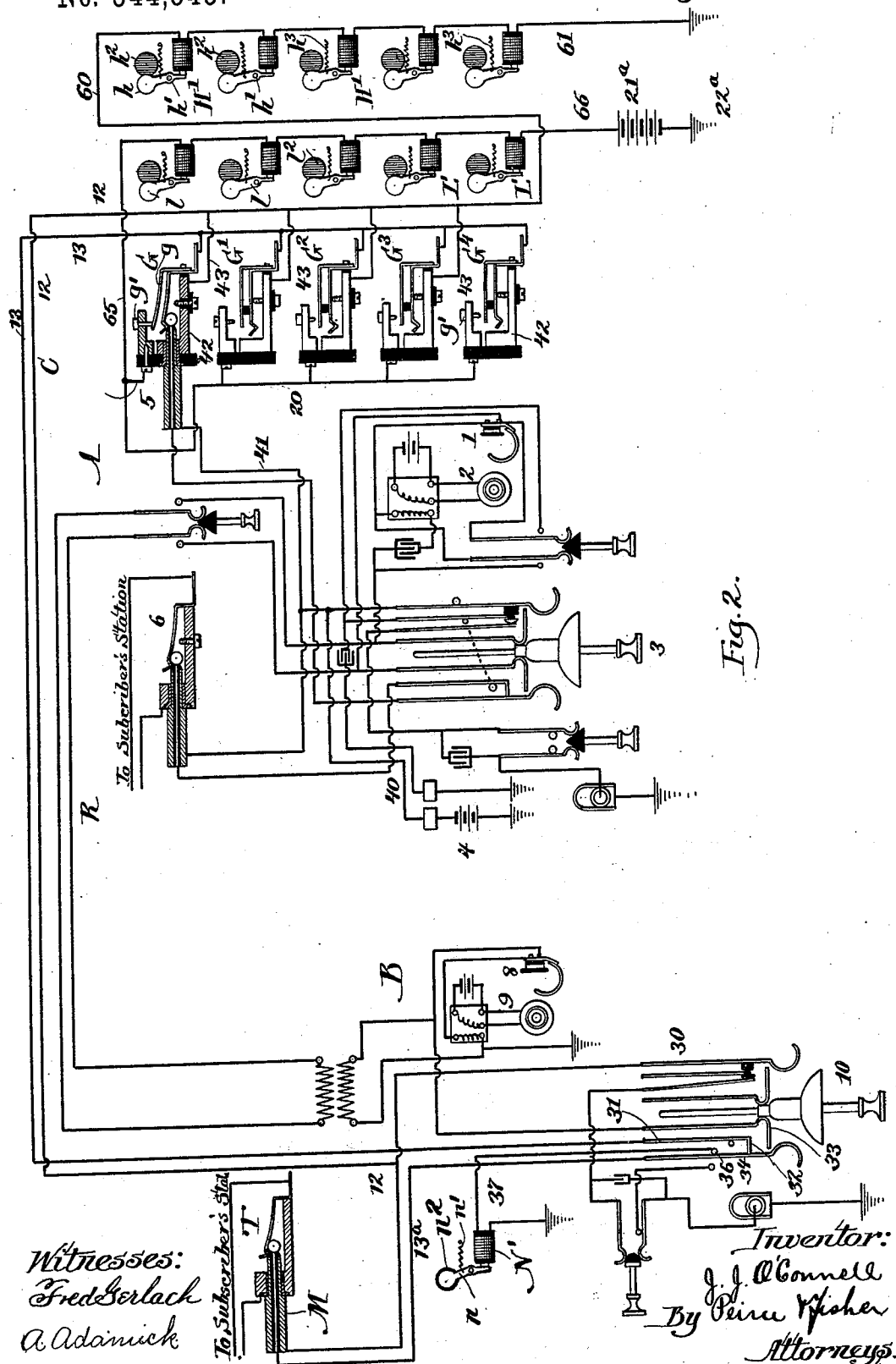


Fig. 2.

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To Subscriber's Station

To Subscriber's Station

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UNITED STATES PATENT OFFICE,

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SIGNAL APPARATUS FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 544,545, dated August 13, 1895.

Application filed April 17, 1893. Serial No. 470,597. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH J. O'CONNELL, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Signal Apparatus for Telephone-Exchanges, of which I do declare the following to be a full, clear, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My present invention has for its object, first, to provide improved means for operating a series of visible signals, whereby the telephone-operator may determine at a glance when any desired line is busy without the necessity of testing various lines to ascertain such fact.

A further object of my invention is to provide improved means for operating visible signals, whereby the operator at the "calling office" may be informed that the operator at a distant office has made the connection called for.

In the operation of telephone-exchange systems it is customary to connect the distant offices by trunk-lines, each of these lines terminating in a trunk-line switchboard at one office and in a terminal switch-cord plug at the other office.

By my present invention the operator is enabled to determine at a glance which trunk-lines are busy. It is desirable for the calling operator, after she has directed the operator at a distant exchange to make the desired connection, to know that such connection has been made, and by my present invention the calling operator is notified when the required connection has been made by a series of visible signals and without the necessity of throwing her head-telephone into the trunk-line circuit to ascertain such fact.

In the operation of telephone systems it is customary to provide at the receiving office a "disconnect-signal" to notify the operator at such office that the trunk-line has been disconnected at the calling office from the subscriber's line, so that the operator at the receiving office can also disconnect the terminal plug of the trunk-line from the subscriber's

switchboard at such office. It has been customary heretofore to operate the disconnect-signal at the receiving office by the passage of current over the trunk-lines, the battery whereby such signal was transmitted being normally in the circuit of said trunk-lines, the circuit of such lines being closed at the calling office and open at the receiving office, except at such times as the trunk-lines were in use. An objection incident to thus arranging the signal-operating battery normally in the circuit of the trunk-lines is that in case either of the trunk-lines become grounded a circuit is established over such wire with the earth and strong induced currents are thereby developed in any of the other trunk-lines that may be in use, frequently rendering conversation over such trunk-lines difficult or impossible.

A further feature of my invention consists in placing the battery (or other source of current) whereby the signals are transmitted normally out of the trunk-line circuit, so that even if any of the lines should become crossed or grounded the danger of induced currents incident thereto will be avoided.

Figure 1 is a diagrammatic view of two telephone-exchanges suitably connected and having my invention applied thereto. Fig. 2 is a similar view showing a modified form of my invention.

Referring more particularly to the construction shown in Fig. 1 of the drawings, A and B designate two exchanges, which for convenience of description will be termed respectively the "calling office" and the "receiving office." In addition to the mechanism necessary to my invention each of these offices will be equipped with the usual apparatus, parts of which are illustrated in the drawings. At the office A is shown an operator's telephone and transmitter 1 and 2, a ringing and listening key 3 of familiar construction, a test-battery 4, and connection-plugs 5 and 6, (one pair only being shown,) whereby the subscribers' lines will be connected with the trunk-lines C that unite the distant exchanges. Other familiar parts are illustrated; but their construction and mode of operation, being well understood, need not be particularly de-

scribed. In like manner, also, the receiving office B is shown as provided with an operator's telephone and transmitter 8 and 9, with a listening and ringing key 10, and with a local signal-circuit D, wherein is arranged a signal-lamp *d* (for convenience termed the "disconnect-signal") that serves to indicate to the receiving operator when a disconnection is to be made. The exchange-offices A and B are connected by trunk-lines C in required number, (one only being shown,) each of these lines comprising two wires 12 and 13 to form a metallic circuit. So, also, the operator's telephones of the exchange-offices will be connected by suitable order-wires R in the usual manner. Each of the trunk-lines C terminates at the calling office A in a series of spring-jacks G, G', G², G³, and G⁴, these jacks corresponding to the several sections of the trunk-line multiple switchboard, and each of the trunk-lines C terminates at the receiving office B in a switch-cord plug M adapted to be inserted in the spring-jacks of the subscriber's multiple switchboard at such office.

The wire 12 of the trunk-line C is connected to the casings of these several spring-jacks G, G', G², G³, and G⁴ and with a relay E, from which a wire leads to ground at W. The armature *e* of this relay E is connected by a wire 15 with the generator 16, and adjacent the armature *e* is the contact-terminal 17 of the wire 18, which leads through the series of signal-lamps H and thence by a wire 19 to the generator. The purpose of the signal-lamps H is to indicate to the operator at the calling office which of the trunk-lines are busy, and it will be seen that when the operator at the calling office has been notified by a subscriber to make a desired connection and has inserted the subscriber's plug 5 in the spring-jack G the relay E will be energized by current passing from the battery 4, by wires 40 and 41, through the sleeve of plug 5 and to the casing 42 of the spring-jack G, thence to the wire 43 and to the wire 12 of the trunk-line, and through this wire to the relay E and thence to ground. When the relay E is thus energized, its armature will be shifted from the position shown in Fig. 1 of the drawings, so as to make contact between the wires 15 and 18 and thus establish the local circuit through the generator 16 and the signal-lamps H, thereby causing these lamps to burn and thus indicate to the operator that the trunk-line is busy. The operator at the calling office is thus enabled to determine at a glance and without the necessity of making test for such purpose which of the various trunk-lines are busy, it being understood, of course, that the lamps H or other signals are placed in juxtaposition to the spring-jacks of the corresponding trunk-lines.

With each of the spring-jacks G, G', G², G³, and G⁴ connects a wire 20 that leads to a relay K, this relay being connected to a battery 21, from which a wire leads to ground at 22. Adjacent the armature *k* of the relay K is the

contact-terminal 23 of the wire 24, which leads through the series of signal-lamps L and thence to the generator 16, a wire 25 connecting the generator with the armature *k* of the relay K. The purpose of the signal-lamps L is to indicate to the calling operator that the receiving operator has made the required connection, and when such connection is made at the receiving office the armature *k* of the relay K will (in manner to be presently defined) be shifted from the position shown, so as to contact with the terminal 23, thereby completing the local circuit through the signal-lamps L, the generator 16, and the wires 24 and 25.

The wire 12 of the trunk-line C is shown as leading directly to the sleeve of the trunk-line switch-cord plug M and also by a branch 12^a to the contact-plate 30 of the listening-key 10 at the receiving office, while the wire 13 of the trunk-line C is shown as leading to the contact-plate 31 of this key. The contact-plate 31 has its free end bent outwardly, as at 32, so that when the key 10 is completely withdrawn (thereby permitting the plate 33 to move inward) the bent end 32 will contact with the plate 34 and thereby complete the circuit through the plates 31 and 34 and the sections of the trunk-line wire 13 and 13^a to the tip of the plug M. When the operator at the receiving office B has been notified by means of the order-wire R to make a desired connection, she will lift the trunk-line plug M from its seat and insert it in the subscriber's spring-jack and will draw out the key 10 completely, as shown in Fig. 2, thereby causing the plate 34 to contact with the terminal 36 of the wire 37 and with the bent end 32 of the plate 31, and thus close a circuit through which current may pass as follows, viz: from the battery 21 through relay K, thence through wire 20 to spring-jack G, thence by trunk-line wire 13 to contact-plate 34 and to the contact-terminal 36 of the wire 37, thence through relay N to ground. The current of battery 21 thus passing through and energizing relay K will cause the armature *k* of this relay to shift from the position shown, so as to touch the terminal contact 23 of the wire 24, thereby closing the local circuit of the generator 16, wherein are interposed the signal-lamps L, causing these lamps to burn and thus indicate to the operator at the calling office that the receiving operator has made the required connection. It will be understood, of course, that the lamps or other signals L correspond in number and arrangement to the spring-jacks of the trunk-line switchboard and will be placed in juxtaposition thereto. When current passes through relay N in manner above described, the armature of this relay will be shifted from the position shown in Fig. 1, so as to open at such point the local circuit of the disconnect-signal lamp *d*, although at the time such breaking of the local circuit is made the signal-lamp is out of action, because there is a break

in the local signal-circuit at the contact R. Consequently, although the local signal-circuit is closed at contact R, the instant that the key 10 is drawn out this local circuit D is broken at the relay N; but inasmuch as the local circuit is closed at R it will be seen that when the relay N is de-energized by throwing the battery 21 out of circuit of such relay the spring n^a will shift the armature of the relay N, so as to close the local signal-circuit of the lamp d and cause this lamp to burn. The throwing of the battery 21 out of circuit is effected by the operator at the calling office withdrawing the plug 5 from the spring-jack G, since when the plug is withdrawn no current can pass over wire 20, because the spring g of the jack G is drawn out of contact from the terminal screw g' of such wire. The signal-lamp d will continue to burn until the operator at the receiving office forces in the key 10, so as to move the contact-plate R' out of connection with the terminal R of the wire 39 adjacent thereto, thereby opening the local signal-circuit D. It is manifest that when the operator at the calling office withdraws the plug 5 from the spring-jack C' the battery 4, which is connected by wires 40 and 41 to the sleeve of the plug 5, is thrown out of the circuit of the relay E, thereby de-energizing such relay and permitting the spring e' to draw backward the armature e from the contact 17, and thus break the connection between the wires 15 and 18, and consequently break the local circuit in which are interposed the signal-lamps H. It will be seen that at the same time that the operator at the calling office withdraws the plug 5 from the jack G the inward movement of the spring g from contact with the terminal screw g' of the wire 20 will break the passage of current over this wire 20 and through the relay K. The relay K will thus be de-energized and the spring K will draw backward the armature k , thereby breaking at contact 23 the local circuit over the wire 24 and through the signal-lamps L, thus throwing these lamps out of action.

While in the construction hereinbefore described, and illustrated in Fig. 1 of the drawings, I have shown the various signals as consisting of incandescent lamps and as arranged in local circuits controlled by individual relays, it is manifest that without departing from the spirit of my invention other forms of signals may be used, and the signals need not be located in local circuits. In the modified form of the invention illustrated in Fig. 2 of the drawings I have shown the busy-signals as consisting of a series of electromagnets H', the armatures h of which are pivoted at h' and have their upper ends expanded, so as to hide the dials h^2 , in front of which the armatures h are normally held by the springs h^3 . The electromagnets H' are connected by a wire 60 with the trunk-line wire 12 and by the wires 43 with the several spring-jack casings 42, and a wire 61 also connects the series

of magnets H' with ground. By this construction it will be seen that when the operator at the calling office A inserts the plug 5 in the trunk-line spring-jack G current will pass from battery 4 by wires 40 and 41 to sleeve of plug 5, thence to casing 42 and by wires 43, 12, and 60 to the electromagnets H', and thence by wire 61 to ground. As current thus passes through the electromagnets H' it will energize such magnets, causing them to attract the armatures h against the force of the springs h^3 and expose the dials h^2 , thereby indicating to the operators at the multiple switchboard that the trunk-line C is busy. In this modification of my invention I have also substituted for the signal-lamp L' (illustrated in Fig. 1) a series of signals consisting of electromagnets L', similar to the magnets H' last above described and having armatures l , which serve to normally obscure the dials l^2 . The magnets L' are connected by a wire 65 with the wire 20 that leads to the terminal screws g' of the several spring-jacks G, G', G², G³, and G⁴. A wire 66 connects the magnets L' with battery 21^a, from which a wire leads to ground, as at 22^a. It will thus be seen that when the operator at the receiving office B has inserted the trunk-line terminal plug M in the subscriber's spring-jack T and withdrawn the key 10, as shown in Fig. 2, current will pass from battery 21^a, by wire 66, through magnets L', by wire 65 to terminal screw g' of spring-jack G, by spring g to trunk-line wire 13, to contact-plate 31 of listening-key 10 at the receiving office B, thence by plate 34 to terminal 36 of wire 37 and by this wire to the electromagnet N', and thence to ground. As current thus passes through magnets L' it will energize these magnets, thereby causing their armatures l to be attracted and expose the dials l^2 , thus indicating to the operator at the office A that the operator at the office B has made the desired connection.

It is manifest that when the operator at the calling office withdraws the plug 5 from the trunk-line spring-jack G the circuits before established through the electromagnets H' and L' will be broken at the spring-jack G, the magnets will be de-energized, and their armatures will be retracted by their springs, so as to obscure their respective dials, thereby showing that the trunk-line C is no longer busy. So, also, it will be seen that when the plug 5 is withdrawn from spring-jack G current will no longer pass from battery 21^a through magnet N', thus de-energizing said magnet and allowing the spring n' to retract the armature n and cause the normally-exposed dial n^2 to show and thus notify the operator at the receiving office that a disconnection has been made at the calling office.

Having thus described the invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a telephone exchange system the combination with a multiple switch board and

with a trunk line leading to the several sections thereof of a series of visible signals corresponding with the trunk line connections of said switch board, a circuit for operating
5 said signals connected to the spring jacks and normally open at such points, a cord plug for insertion in said spring jacks adapted when inserted in any one of said jacks to close
10 said signal circuit at such point and a source of current (such as a battery) for controlling said signal circuit, said source of current being in circuit with the plug cord, whereby
15 when said plug is inserted in a spring jack of the multiple board, current will be caused to pass over said signal operating circuit.

2. In a telephone exchange system, the combination with a multiple switch board of a series of visible signals corresponding with the spring jacks of said switch board, a circuit for operating said signals having branch
20 connections leading to each of the corresponding spring jacks of the multiple board, said circuit being normally open at said jacks, a cord plug for insertion in said spring jacks
25 and adapted when inserted in any one of said jacks to close said signal circuit at such point, and a source of current (such as a battery) for controlling said signal circuit, said source of current being in circuit with the cord of
30 said plug, whereby when said plug is inserted in any spring jack of the multiple board current will be caused to pass over said signal operating circuit.

3. In a telephone exchange system, the combination with a multiple switch board and
35 with a trunk line leading to the several sections thereof, of a series of visible signals corresponding to the several sections of said multiple switch board, a circuit for operating
40 said visible signals connected to the several switch board terminals of the trunk line at one office, and a source of current (such as a battery) for said circuit, said source of current being in circuit with the conversation
45 wire of the trunk line whereby said source of current serves not only as a signal actuating battery but also as a test battery for the various terminals of the multiple switch board.

4. In a telephone exchange system, the combination with a multiple switch board of a series of visible signals corresponding with the trunk line connections of said switch board,
50 said visible signals being arranged in a local circuit, means for closing said local circuit in order to bring said signals into action when the trunk line is in service, a relay for controlling
55 said local circuit, said relay being in circuit with the several spring jacks of the multiple board, and a source of current (such as a battery) for operating said relay, substantially as described.

5. In a telephone exchange system, the combination with a multiple switch-board of a series of lamps corresponding with the trunk
65 line connections of said switch-board, said lamps being arranged in a local circuit, a re-

lay for closing said local circuit to bring said lamps into action when the corresponding trunk line is in service, said local circuit being controlled by the armature of said relay,
70 a generator also interposed in said local circuit, and a source of current in circuit with said relay and with the trunk line terminals of the switch board, whereby the passage of current through said relay is controlled at
75 said switch board terminal, substantially as described.

6. In a telephone exchange system, the combination with a trunk line extending between two stations and provided at each with suitable switch terminals, of a visible signal and
80 a circuit for operating said visible signal leading to the switch terminal of the trunk line at one station but normally disconnected from said trunk line at said terminal, means
85 (such as a cord-plug) for closing said signal operating circuit at said terminal, a battery for said circuit connected to the conversation wire of the trunk line but normally out of the circuit of said line, and means at the other
90 station for establishing flow of current from said battery over the signal operating circuit and over the conversation wire of the trunk line when the trunk line terminal of said other station is put into use.

7. In a telephone exchange system, the combination with a trunk line connecting offices and a multiple switch board at one of said offices, of a series of visible "busy" signals
100 corresponding with the trunk line connections of said multiple switch board, and a series of visible signals for indicating at one office that the desired connection has been made at the other office, circuits wherein said visible signals are placed, said circuits being connected
105 with the multiple switch board terminals at the office at which said signals are located, but being normally disconnected from the trunk line at said terminals.

8. In a telephone exchange system, the combination with a trunk line connecting offices and a multiple switch board at one of said offices, of a series of "busy" signals located
110 at the calling office and corresponding with the trunk line connections of said switch board, a second series of visible signals for indicating at said office that the desired connection has been made at the receiving office, individual signal controlling circuits for each
115 of said series of visible signals, said individual circuits being connected with the trunk line terminals of the multiple switch board, means (such as a cord plug) for connecting said individual circuits with the trunk line
120 when said line is brought into use, a source of current located at the calling office and interposed in one of said individual circuits, a second source of current adapted to be connected through the medium of the trunk line
125 with said other individual circuit, and means at the receiving office for bringing said second source of current into the trunk line circuit.

cuit to cause said second series of signals to indicate that the desired trunk line connection has been completed.

9. In a telephone exchange system, the combination with a trunk line connecting offices and a multiple switch-board at one of said offices, of a series of visible "busy" signals corresponding with the trunk line connections of said switch-board, and a series of visible signals for indicating at one office that the desired connection has been made at the other office, local circuits wherein said visible signals are placed, relays for controlling said local circuits and a battery suitably connected with both of said relays for operating the same at proper times.

10. In a telephone exchange system, the combination with a trunk line connecting offices and a multiple switch-board at one of said offices, of a series of visible "busy" signals corresponding with the trunk line connections of said switch-board, and a series of visible signals for indicating at one office that the desired connection has been made at the other office, local circuits wherein said visible signals are placed and a generator located in both of said local circuits and suitable means for controlling said local circuits, substantially as described.

11. In a telephone exchange system, the combination with a line connecting the offices and having suitable switch board terminals and suitable switch boards for said line, of a visible disconnect signal at one office adapted to be controlled by passage of current over said line, a visible signal (one or more) at the other of said offices and connected with the switch board of said office, and a source of current (preferably a battery) for causing the operation of both of said signals and arranged normally out of the circuit of the line connecting the offices, a relay for controlling said disconnect signal at one office and a relay for controlling the signal at the other office, and suitable connections whereby the operation of the terminals of the line con-

necting the offices shall effect the operation of said relays to control said signals, substantially as described.

12. In a telephone exchange system, the combination with a line connecting two offices and having suitable switch board terminals, of a visible dis-connect signal located at the receiving office, a circuit for controlling said signal adapted to be actuated by current passing over the line between the offices, an operator's key at the receiving office for making and breaking the connection between said signal controlling circuit and said line extending between the offices, a source of current (such as a battery) for said signal controlling circuit, said source of current being normally dis-connected at the calling office from the line between the offices, and suitable means (such as a cord plug) at said calling office whereby said source of current is thrown into and out of circuit with the line between the offices.

13. In a telephone exchange system, the combination with a line connecting two offices and having suitable switch board terminals, of a visible dis-connect signal located at the receiving office, a relay at said office for controlling said signal adapted to be actuated by current passing over the line between the offices, suitable means (such as an operator's listening key) at the receiving office for making and breaking the connection of said relay with the line between the offices, said line being normally broken at said key, and a source of current (such as a battery) for operating said relay normally dis-connected at the calling office from the line between the offices but arranged to be thrown into circuit with said line, when the terminal of said line at the calling office is connected with the switch board at said office for the passage of current.

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