

(No Model.)

2 Sheets—Sheet 1.

J. J. CARTY.  
TELEPHONE EXCHANGE APPARATUS.

No. 427,742.

Patented May 13, 1890.

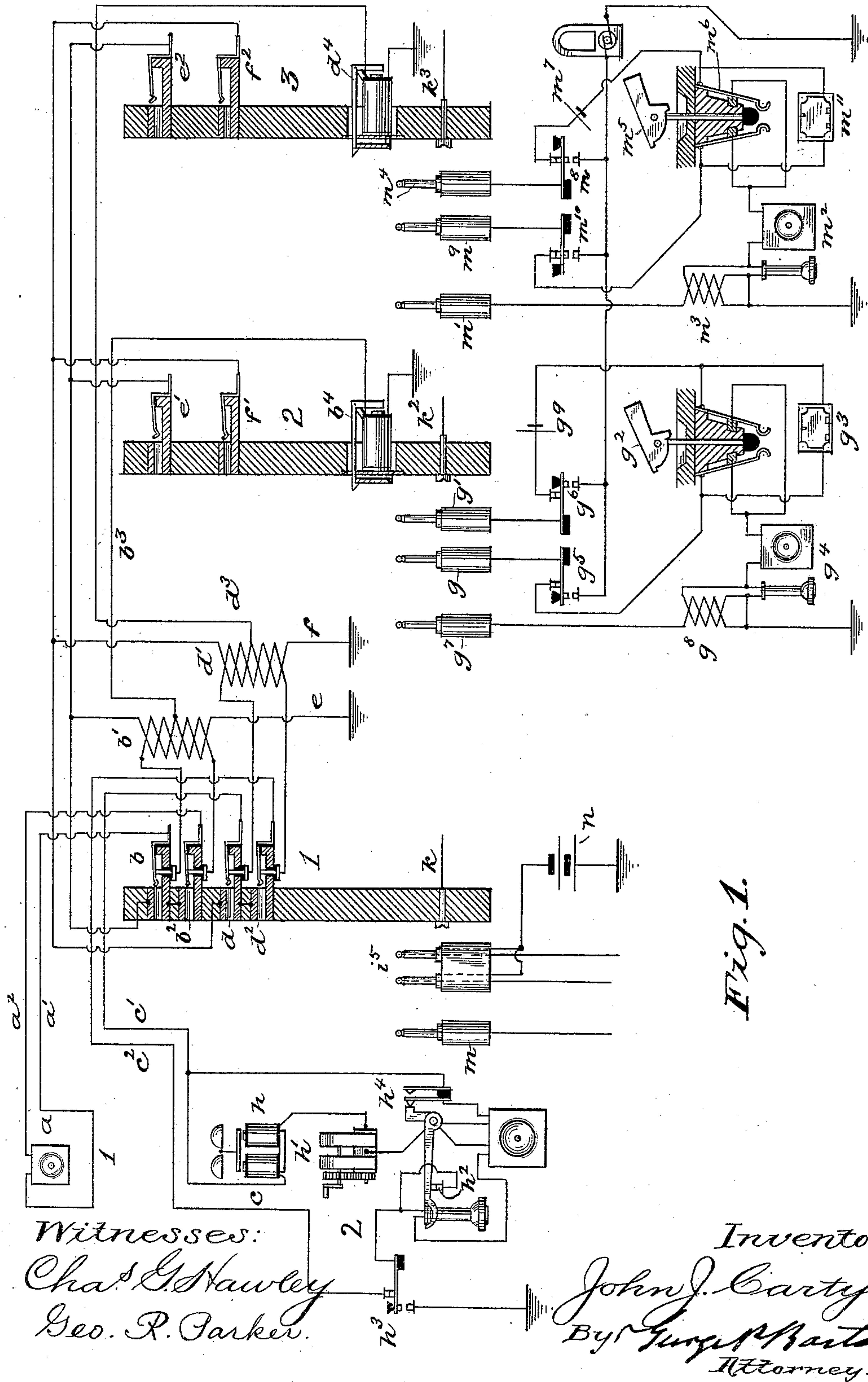


Fig. 1.

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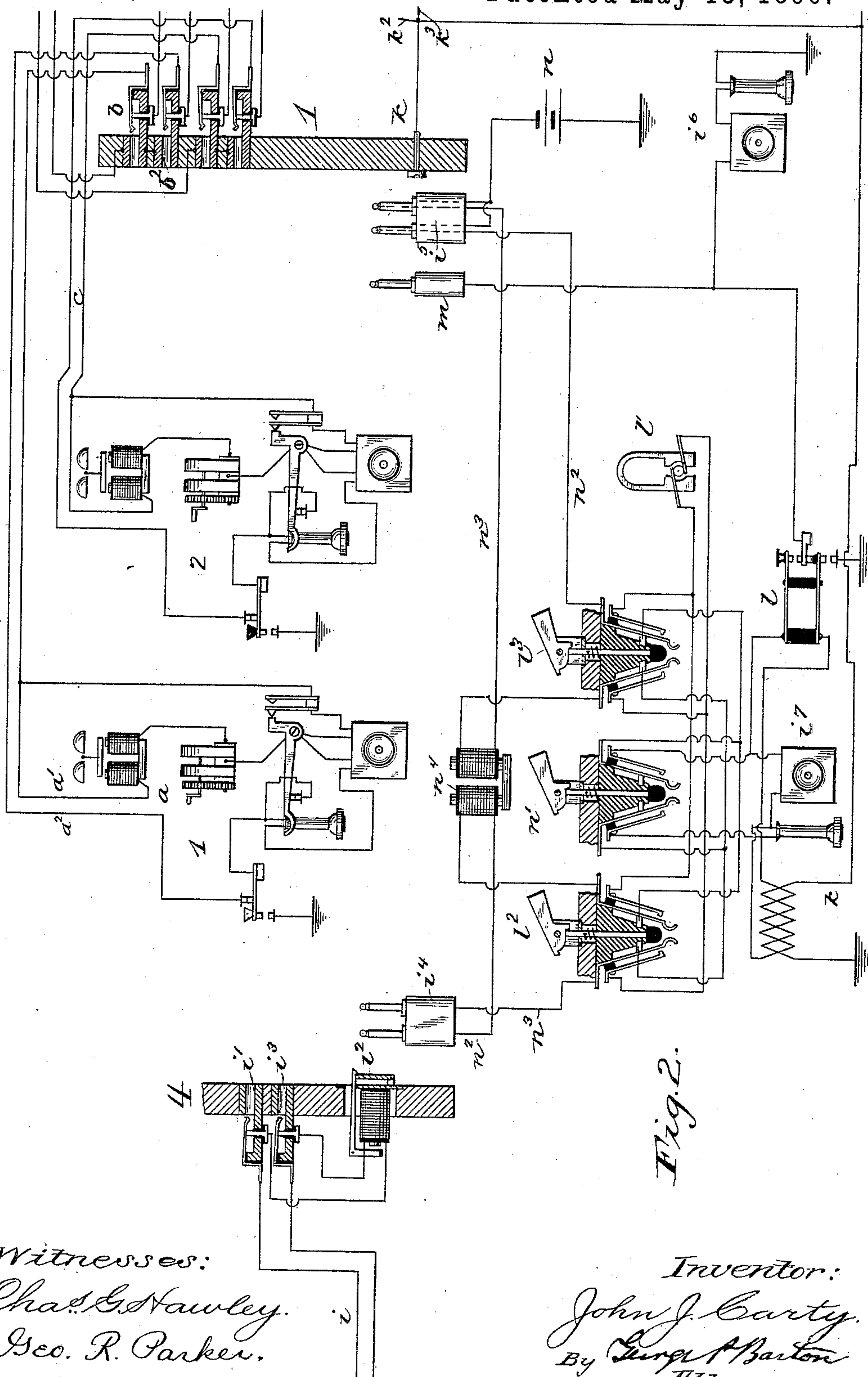
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# UNITED STATES PATENT OFFICE.

JOHN J. CARTY, OF NEW YORK, N. Y., ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS.

## TELEPHONE-EXCHANGE APPARATUS.

SPECIFICATION forming part of Letters Patent No. 427,742, dated May 13, 1890.

Application filed March 23, 1889. Serial No. 304,505. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN J. CARTY, a citizen of the United States, residing at New York city, in the county of New York and State of New York, have invented a certain new and useful Improvement in Telephone-Exchange Apparatus, (Case 3,) 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 multiple switch-board systems of telephone-exchange; and its objects are, first, to reduce the amount of wiring required between the different boards, and, second, to reduce the size of the switches, so that a larger number of lines may be brought within the reach of each operator.

My invention is particularly designed for use in connection with metallic-circuit telephone-lines; and it consists in telephone-lines each connected with a different spring-jack switch upon one of the switch-boards, each line being connected, through an induction-coil or converter, with metallic sockets on other boards, one for each line on each of two or more other switch-boards.

My invention consists, also, in apparatus for making the connections between trunk lines and the spring-jack switches upon the first switch-board, together with certain details of construction and combinations of parts hereinafter described.

In the drawings, which are illustrative of my invention, Figure 1 is a diagram showing two telephone-lines, each connected with a different double spring-jack switch on the first board and each, through the medium of a converter, with different metallic sockets on each of two other boards, each line being provided with a different branch from one of the coils of its converter, which branches extend each through a different individual annunciator to ground, operators' outfits being provided at the boards containing the metallic sockets. Fig. 2 is a diagram showing two subscribers' stations and lines extending to the first board with apparatus for connecting said lines with a trunk-line.

Like parts are indicated by similar letters and numerals of reference throughout the different figures.

Referring now to Fig. 1, subscriber's station 1 is connected with the central office by a telephone-line  $a$ , consisting of two branches or limbs  $a'$   $a^2$ . The circuit of limb  $a'$  may be traced through the spring and contact of spring-jack switch  $b$ , and thence through one winding of the converter  $b'$  to the contact-point of spring-jack switch  $b^2$ , and thence to the spring of said switch  $b^2$ , with which spring the other branch or limb  $a^2$  is connected, and thence over said limb  $a^2$  back to station 1. The coil of converter  $b'$ , which is included in the circuit thus traced, is provided with a branch  $b^3$ , which passes through the individual annunciator  $b^4$  of the line, and thence to ground. (For a detail of the apparatus at station 1 see station 1, Fig. 2.)

The telephone-line  $c$  of subscriber's station 2 consists of two branches or limbs  $c'$   $c^2$ , limb  $c'$  being connected through spring-jack switch  $d$ , and thence through a coil of repeating coil  $d'$ , and thence the circuit may be traced through the contact and spring of spring-jack switch  $d^2$ , and thence to subscriber's station 2 over limb  $c^2$ . A branch  $d^3$  from the coil of converter  $d'$ , which includes circuit  $c$ , extends, as shown, through individual annunciator  $d^4$  to ground.

It will be observed that the frames or test-pieces of the spring-jack switches  $b$   $b^2$  are electrically connected; also, the frames of switches  $d$   $d^2$  of line  $c$ . One coil of converter  $b'$  is included in the circuit of line  $a$  and a coil of the converter  $d'$  in the circuit of line  $c$ . The individual annunciator  $b^4$  of line  $a$  is included in a wire  $b^3$ , connected, preferably, with the center of the coil of converter  $b'$ , which is included in line  $a$ . The individual annunciator  $d^4$  of line  $c$  is in a similar manner included in the branch  $d^3$ , which extends to the center of that coil of  $d'$  which is included in circuit of line  $c$ . The other coil of converter  $b'$  includes a wire  $e$ , which extends to socket  $e'$  upon board 2 and to socket  $e^2$  upon board 3. The second coil of converter  $d'$  is included in like manner in a wire  $f$ , extending from ground through said coil to a socket  $f'$  on board 2 and a corresponding socket  $f^2$  on board 3.

At board 2, I have shown an operator's outfit consisting of a pair of connecting-cords



with terminal plugs  $g$   $g'$ , a cam-lever switch  $g^2$ , a clearing-out annunciator  $g^3$ , connected between the two contact-springs of the switch, the telephone  $g^4$  in a branch extending from ground through said telephone to the telephone-contacts of the switch  $g^2$ , a pair of calling-keys  $g^5$   $g^6$ , included in circuit of said connecting-cords, and a test-plug  $g^7$ , included in a ground branch, which ground branch includes one coil of an induction-coil  $g^8$ , the other coil of said induction-coil being in a bridge across the telephone terminals. The test-battery  $g^9$  is included in the cord connecting with the plug  $g'$ . Similar operator's apparatus is shown at board 3.

Referring now to the apparatus of the subscriber at station 2 it will be seen that when the telephone is hung upon the switch, as shown, the bell  $h$  and generator  $h'$  will be included in the circuit of wire  $c$ —that is to say, the side or limb  $c'$  is connected through the bell  $h$  and the generator  $h'$  to the telephone-switch, and thence to the lower contact  $h^2$  of the switch, and thence through key  $h^3$  to limb  $c^2$ . On removing the telephone from the switch the lower contact  $h^2$  is opened and the telephone-contact  $h^4$  is closed, thus looping the telephone into circuit.

The individual annunciators of the local lines are preferably distributed on boards 2 3, &c., which are provided with the simple metallic sockets. The local connections will thus be made upon the boards 2 3, and not upon the board 1, which contains the double-spring-jack switches  $b$   $b^2$   $d$   $d^2$ . This first board 1, I reserve for making the trunk or toll line connections, and it may be placed, if desired, in a room by itself. Thus in Fig. 2 I have shown two subscribers' stations 1 and 2 connected with board 1 and a toll-line or trunk-line operator's outfit. I will suppose that the long-distance lines are connected with a separate board 4. It is evident, however, that they might be provided with switches upon board 1, if desired. I have shown the metallic-circuit long-distance line  $i$  connected through spring-jack switch  $i'$ , annunciator  $i^2$ , and thence through the other spring-jack switch  $i^3$  of the pair. It is necessary to be able to connect any one of the long-distance lines  $i$  with any one of the local telephone-lines  $a$   $c$ .

The calls of the different local lines will be received by the operators at the different local boards 2 3 in the usual manner. Any local operator receiving a call for an extra territorial line (as toll-lines and other lines not belonging to the local system are sometimes called) will notify the operator at board 4 of the call, giving the number of the subscriber calling and the number or name of the extra territorial line with which the calling subscriber has asked connection.

The connection between any local telephone-line, as line  $a$ , and any extra territorial line, as line  $i$ , may be made by loop-plugs  $i^4$   $i^5$ , connected, as shown, by flexible cords when

inserted, respectively, in switch device  $i$   $i^3$  of line  $i$  and the switch device  $b$   $b^2$  of line  $a$ . In this manner a local line and an extra territorial line may be looped together in metallic circuit without including in the circuit any unnecessary resistance.

In large exchanges I preferably place an operator at each of the boards 4 and 1, each being provided with a telephone-set so arranged that they can communicate with one another, as desired. Thus at board 1, I have shown telephone-set  $i^6$ , and at board 4 telephone-set  $i^7$ . The local telephone-line  $k$  is connected with telephone-set  $i^7$ , and extends thence to terminals  $k'$ ,  $k^2$ , and  $k^3$  on the different boards 1 2 3. The call from any of the local boards, as 1 or 2, is repeated over line  $k$  to the operator at board 4, listening at telephone  $i^7$ . The operator at telephone  $i^7$ , by depressing the pair of keys  $l$ , puts herself in communication with operator at board 1, listening at telephone  $i^6$ . The generator  $l'$  is connected with appropriate contacts of ringing-keys  $l^2$   $l^3$ . By depressing  $l^2$  current will be sent from generator  $l'$  over any line  $i$  with which the twin plug  $i^4$  is connected. By depressing ringing-key  $l^3$ —that is, by forcing down the piston thereof—the generator  $l'$  is brought into circuit with the cords connecting with the different terminals of twin plug  $i^5$ . The operator at board 4 may thus ring in either direction to signal over a long-distance wire or over any local line with which she may be connected.

Each of the operators at the local boards is provided with a test-plug connected with her telephone for determining whether any line wanted or called for is already connected or in use. Thus test-plug  $m$  is provided at board 1, the circuit of which is connected with telephone-set  $i^6$ . Test-plug  $g^7$  is provided at board 2, as before described, and a test-plug  $m'$  is provided at board 3, connected with the operator's telephone  $m^2$  through a converter  $m^3$ .

I will now describe the manner of connecting any two local lines together upon one of the switch-boards 2 3. I will suppose that subscriber 2 wishes connection with subscriber 1. He depresses key  $h^3$  and turns generator  $h'$ , thus sending current over limb  $c'$  through switch  $d$  to coil  $d'$  and thence over branch  $d^3$  through individual annunciator  $d^4$  on board 3 to ground. The operator at board 3 seeing shutter  $d^4$  fall, immediately lifts plug  $m^4$  and inserts the same into socket  $f^2$  corresponding to line  $c$ . The listening-in switch  $m^5$  being thrown to the position shown, the telephone  $m^2$  will be brought into the circuit of wire  $f$ . The circuit thus formed may be traced from ground near telephone  $m^2$  through said telephone, thence to the telephone-contacts of listening-in key  $m^5$ , thence to the springs of said listening-in key resting upon said contacts, and thence from the spring  $m^6$  through test-battery  $m^7$  and calling-key  $m^8$  to the cord of plug  $m^4$ . This plug  $m^4$  being inserted in



socket  $f^2$ , the circuit may be traced over wire  $f$  through the winding of converter  $d'$ , included in the circuit of wire  $f$ , to ground. In the meantime the subscriber at station 2 has let  
 5 go of key  $h^3$  and taken down his telephone. Contact  $h^2$  is thus opened, and the telephone-contact and local contact at  $h^4$  being closed the telephone is brought into the circuit of wire  $c$ . The operator at board 3 and the sub-  
 10 scriber at station 2 are thus brought into telephonic communication. The subscriber having given his order, the operator first, by means of plug  $m'$ , tests the line called for. If the line tested is busy, a click will be heard in tele-  
 15 phone  $m^2$  when plug  $m'$  is touched to the switch of the line tested. If, however, the line is free, she will hear no click.

I will assume that the line called for was line  $a$  and that the plug  $m'$  having been ap-  
 20 plied to socket  $e^2$  no click was heard in the telephone. The operator thereupon inserts the other plug  $m^9$  of the pair in socket  $e^2$  and depressing key  $m^{10}$  throws current over wire  $e$ , in the circuit of which is included one wind-  
 25 ing of the converter  $b'$ . This, in a manner well understood, will induce a current in the metallic circuit  $a$ , connected in the other coil of the converter, and thus the bell included in the circuit of line  $a$  at station 1 (for detail  
 30 see Fig. 2) will be rung. The subscriber at station 1, taking down his telephone, will disconnect his bell and bring his telephone into circuit. The two subscribers will then be in telephonic communication—that is to say, the  
 35 loop or metallic circuit  $c$  will include the telephone of subscriber 2 and one winding of converter  $d$ . The metallic circuit or loop  $a$  will include the telephone of subscriber 1 and a winding of converter  $b'$ . The wires  
 40  $e f$ , which include the other windings, respectively, of the converter, will be connected together by means of the plugs  $m^4 m^9$  and the flexible cords connected therewith. On throwing up the cam-lever of key  $m^5$  the  
 45 clearing-out annunciator  $m^{11}$  is brought into the circuit of the cords. When the subscribers are through talking, either may clear out in the ordinary manner by hanging up his telephone and turning his generator. Sup-  
 50 posing one of two lines connected upon board 3 should be called for at another board—as, for example, board 2—it will be observed that the test-battery  $m^7$  is included in the circuit of wires  $e f$  when two subscribers are con-  
 55 nected, as above described. There will thus be battery-current present at all the other sockets of the connected lines upon other boards. The operator then at another board, as board 2, by simply touching the tip of plug  
 60  $g^7$  upon socket  $f'$  would get battery-current through the coil of converter  $g^8$ , connected with telephone  $g^4$ . Thus a click would be heard in the telephone, and she would know that the line  $c$  was busy, and would inform the  
 65 one who had asked for line  $c$  of the fact. It should be observed that the wire  $f$  is branched

to the frame of the double switch  $d d^2$  upon the first board and the wire  $e$  is branched to the frame of the double switch  $b b^2$ . Thus plug  
 70  $m$  may be used for testing at board 1. The loop-plug  $i^5$  at board 1 is provided with two tips, each tip being insulated from a metallic sleeve upon the shank of each of the two parts. These sleeves are connected with the test-bat-  
 75 tery  $n$ . When, therefore, twin plug  $i^5$  is inserted in the switch device of any line, the frame of said switch device with which the sleeves come in contact will be connected with battery  $n$ . Thus any line is made to test  
 80 busy at all the boards when connection is made therewith at any of the boards, whether the connection be at the first board or at one of the local boards 2 3, &c.

I will suppose now that subscriber 2 wishes connection with a long-distance line,  
 85 as line  $i$ , he will call the same as if he desired a local connection. Throwing down shutter  $d^4$  the operator will make connection, as before described, by means of plug  $m'$  and find out what is wanted. Finding that it is a  
 90 trunk-line connection wanted, the operator will apply the other plug  $m^9$  to socket  $k^3$ , thus bringing herself into communication with the operator listening at telephone  $i^7$  of long-dis-  
 95 tance board 4. She will thereupon inform long-distance operator that subscriber 2 wishes connection with long-distance wire  $i$ . Operator at board 4 will thereupon depress key  $l$  to connect with telephone  $i^6$  of operator at board 1,  
 100 and will tell operator at board 1 to make connection with line  $c$  of subscriber 2. This she will do by inserting twin loop-plug  $i^5$  in double switch  $d d^2$  of line  $c$ . Operator at board 4 will  
 105 at the same time insert twin plug  $i^4$  into the switch  $i i^3$ . By means of calling-key  $l^2$  current from generator  $l'$  may be sent over the long-dis-  
 110 tance wire and by means of key  $l^3$  current may be sent over the circuit of subscriber 2. By means of listening-key  $n'$  operator at board 4 may bridge telephone  $i^7$  between the cords  $n^2 n^3$ .  
 115 One coil of the clearing-out annunciator  $n^4$  is included in cord  $n^2$  and the other coil in cord  $n^3$ . These coils, being wound in opposite directions, will act together upon the armature. If a call is sent in over a long-distance line,  
 120 as line  $i$ , the shutter  $i^2$  will be thrown down and the operator, inserting twin plug  $i^4$  in double switch  $i i^3$  and throwing up the cam-lever of listening-key  $n'$ , will bring telephone  $i^7$  into circuit. Having received the order, she  
 125 will operate key  $l$  and repeat the order to the operator at board 1, and the operator at said board 1 will, after having found that the line wanted is not in use, insert the twin plug cor-  
 130 responding to the one in use at board 4 into the double switch of the line wanted. The insertion of twin plug  $i^5$  will cause the line with which connection is thus made to test busy at all other boards, as boards 2 3. The test-plug  $m$  may be applied to socket  $k'$  when-  
 135 ever operator at board 1 wishes to connect with operator at board 4. The repeating coils



or converters  $b'$   $d'$  may consist each of two coils, say, having a resistance each of one hundred and sixty ohms.

It will be seen that any telephone-line connected upon the first board is cut off from the repeating-coil and all the connections in the remaining boards of said line. Thus connections with long-distance lines are practically free from resistance. For local connections, however, the small amount of resistance introduced into the circuit by the repeating-coils will not be harmful. The ground branches  $b^3$   $d^3$  are preferably connected at the center of those coils of the converters  $b'$   $d'$  which are included in the metallic-circuit telephone-lines, so that when these telephone-lines are used for talking they will not be made noisy. The feature of this part of my invention is having the grounded annunciator branches connected with the metallic circuits at their neutral points—that is to say, at some point near the center of resistance. An additional advantage in having the grounded annunciator branch connected at or near the center of resistance is that when the subscriber rings off—that is to say, when he turns his generator to signal the central office to disconnect—current will not be sent through this grounded branch to operate the individual annunciator. The economy of my system when applied to very large exchanges will be apparent, since spring-jack switches upon the local boards are not required. The number of connections for each line upon the local boards being greatly diminished, the problem of cabling—that is, of disposing of the wires at the rear of the boards—is made very simple.

The busy test which I have shown is found to be satisfactory. Other systems might, however, be used with good results.

It is apparent that my invention admits of various other modifications which will readily suggest themselves to those skilled in the art, and I therefore do not limit myself to the details of construction described herein.

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

1. The combination, with a telephone-line connected with a switching device upon the switch-board of a telephone-exchange, of a converter, one coil of said converter being included in said telephone-line, a branch from said coil extending to ground and containing an individual annunciator upon one of two or more other switch-boards of the exchange, the other coil of said converter being included in a branch wire extending from ground through said other coil and having a connection or socket upon each of said other local boards.

2. A subscriber's apparatus consisting of a telephone, a telephone-switch operated thereby, a bell and generator, and a key for grounding the portion of the circuit containing the generator and bell, said circuit extending in

two branches or limbs to the central station and including one coil of a converter, a branch from said coil to ground through an individual annunciator upon one of two or more switch-boards, a branch wire connected with ground and passing through the other coil of said converter and extending to a different socket or connection upon each of said switch-boards, whereby the subscriber may signal the central office and bring his telephone into a metallic circuit including one of the coils of the converter, the voice-currents sent over said metallic circuit being induced upon the ground branch containing the other coil, substantially as and for the purpose specified.

3. A metallic-circuit telephone-line including a subscriber's outfit and a key for grounding one side or limb of said circuit to ground at the subscriber's station, a converter at the central office having one coil included in said metallic circuit, and a branch from the center of said coil through an annunciator to ground, whereby the subscriber on operating his grounding-key may complete a circuit from his station through said annunciator, substantially as and for the purpose specified.

4. The combination of a switch-board provided with double spring-jack-switch devices with which different telephone-lines are connected, each telephone-line being provided with a different converter and including a coil thereof, and each being provided with a branch extending from said coil of its converter to ground through an individual annunciator upon one of several local switch-boards, a wire for each telephone-line including the other coil of the converter thereof and extending to a different switch or socket on each of the local boards and to the insulated frame of the double spring-jack device of its line upon the first board, a subscriber's outfit upon each of said telephone-lines, an operator's apparatus at each of the local switch-boards, one or more long-distance or extra-territorial lines, and an operator's outfit at the terminal of said long-distance or extra-territorial line connected with an operator's outfit at the board containing the double spring-jack devices of the local lines, whereby an operator at one of the local boards on receiving a call for an extra-territorial line may notify the long-distance operator thereof, whereupon the long-distance operator, in conjunction with the operator at the first board, may connect the local line with the extra-territorial line in metallic circuit, and whereby the long-distance operator, upon receiving a call for connection with a local line, may test said local line and make connection therewith, substantially as and for the purpose specified.

5. A metallic-circuit telephone-line provided with a double spring-jack-switch device upon the first board and connected, through the medium of a converter, with other local switch-boards, a long-distance line, provided also with a double spring-jack-switch device, and a pair of twin plugs and connecting-cords,



each cord including a different coil of a clearing-out annunciator wound oppositely, whereby the long-distance line and the local line may be looped together, substantially as and for the purpose specified.

6. A telephone-circuit consisting in the combination of two wires, each of said wires being provided with a switching device upon the first board and connecting, through the medium of a converter, with the local switch-boards, a long-distance line also provided with a switching device, and connecting cords and plugs whereby the long-distance line and the local line may be connected together, substantially as and for the purpose specified.

7. The combination, with a telephone-line passing through a switching device at one section of a multiple-board and through one coil of a converter, of a branch wire extending through another coil of said converter to all of the sections of said multiple-board.

8. A metallic circuit extending from a subscriber's station to the central office and including at said central office one coil of a con-

verter, in combination with a branch from said coil to ground through an electro-magnetic device and a branch circuit from ground at the central office including the other coil of said converter, said branch extending to one or more switch-connecting devices at the central office, substantially as and for the purpose specified.

9. A metallic-circuit telephone-line including a subscriber's station provided with a generator and switching devices, in combination with a branch from the center of the resistance of said line at the central office through an annunciator to ground, whereby the subscriber may bring his generator into a grounded circuit including said annunciator, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 19th day of February, A. D. 1889.

JOHN J. CARTY.

Witnesses:

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W. S. ECKERT.