

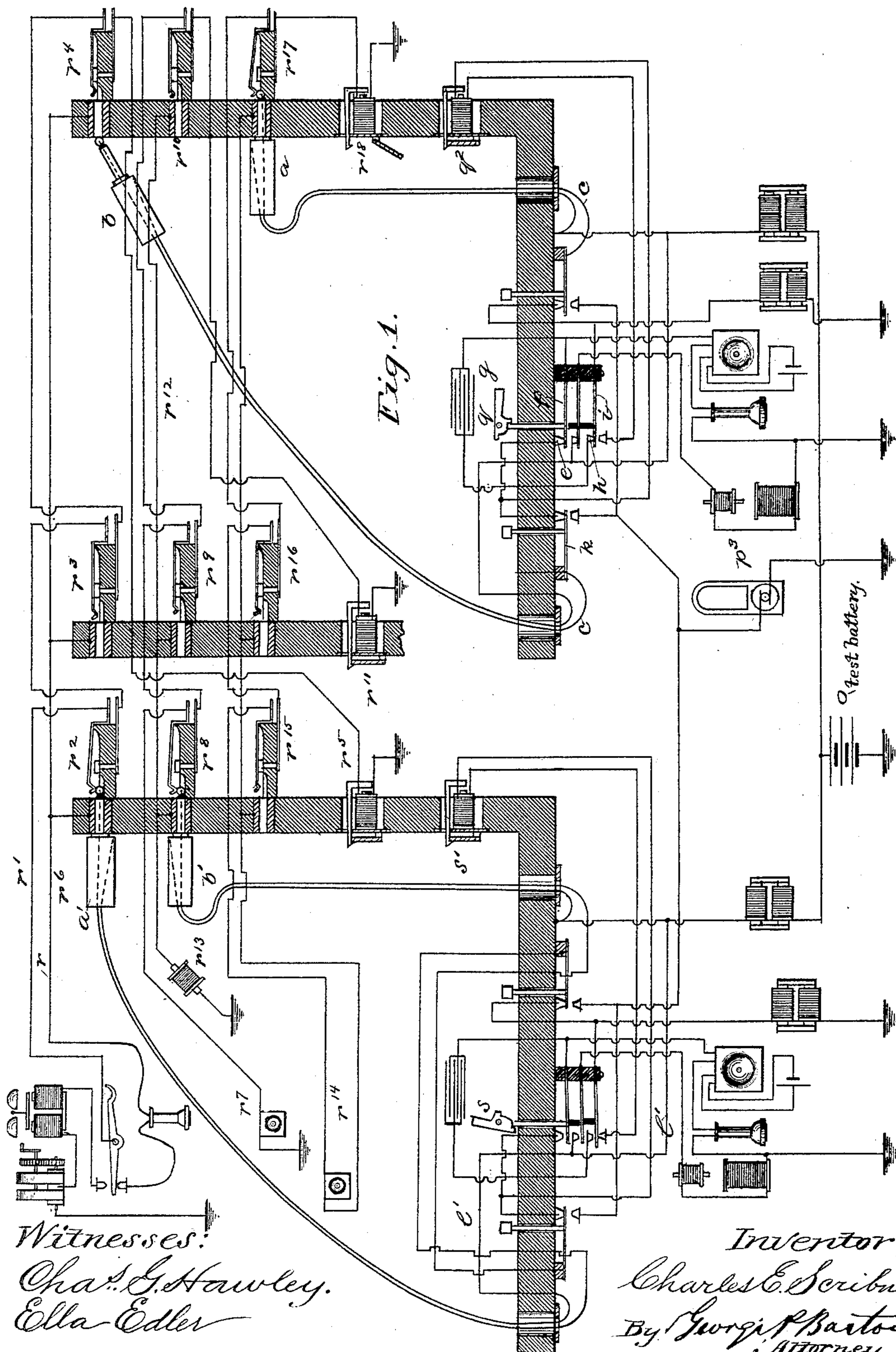
(No Model.)

2 Sheets—Sheet 1.

C. E. SCRIBNER.
MULTIPLE SWITCH BOARD SYSTEM.

No. 442,145.

Patented Dec. 9, 1890.



Witnesses:
Chas. G. Hawley.
Ella Edler

Inventor;
Charles E. Scribner
By George P. Barton
Attorney.

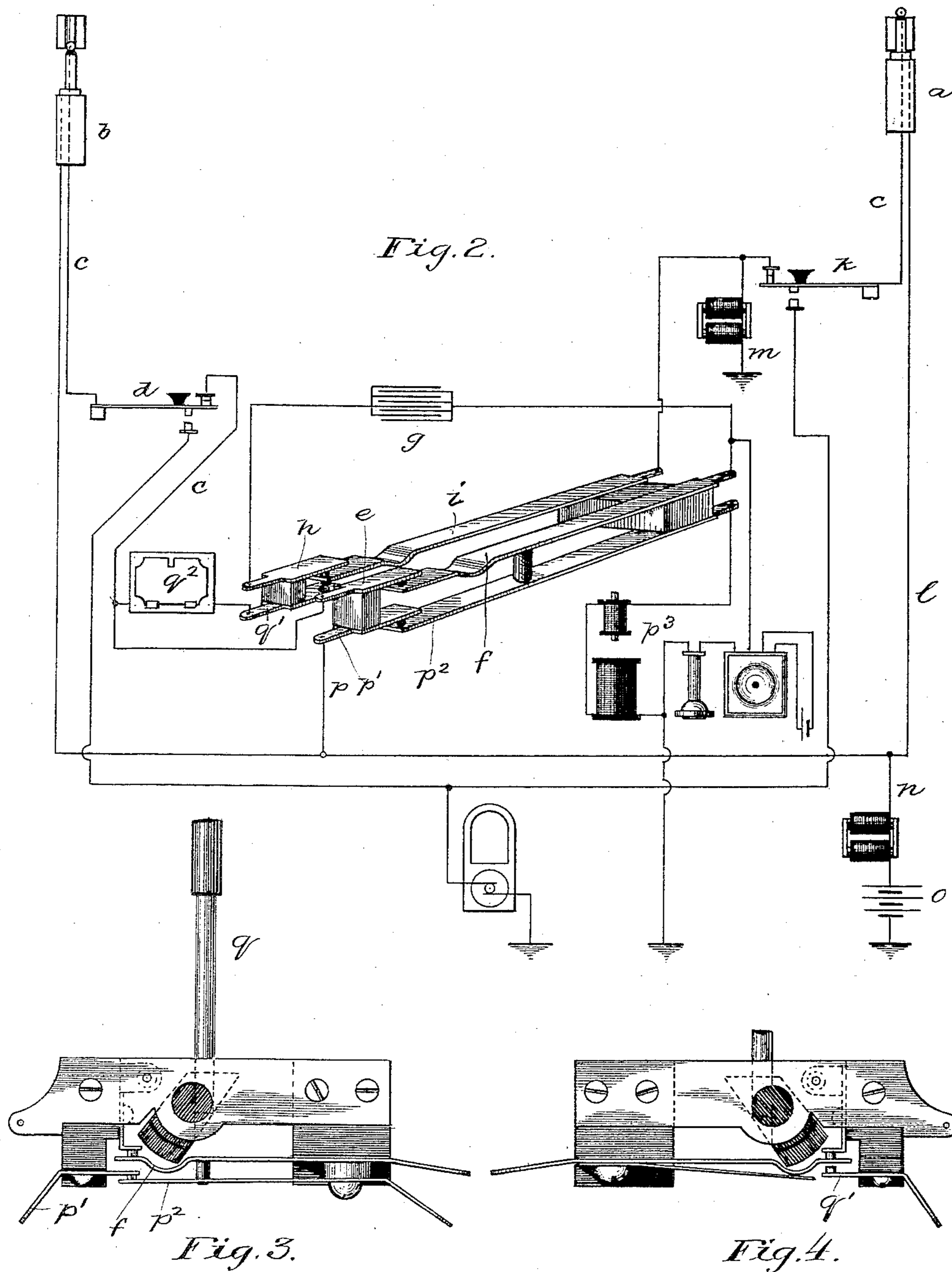
(No Model.)

2 Sheets—Sheet 2.

C. E. SCRIBNER.
MULTIPLE SWITCH BOARD SYSTEM.

No. 442,145.

Patented Dec. 9, 1890.



Witnesses:

Chas. G. Hawley
Ella Edler

Inventor:

Charles E. Scribner
By George P. Barton
Attorney.

UNITED STATES PATENT OFFICE.

CHARLES E. SCRIBNER, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE WESTERN
ELECTRIC COMPANY, OF SAME PLACE.

MULTIPLE-SWITCH-BOARD SYSTEM.

SPECIFICATION forming part of Letters Patent No. 412,145, dated December 9, 1890.

Application filed November 23, 1888. Serial No. 291,659. (No model.)

To all whom it may concern:

Be it known that I, CHARLES E. SCRIBNER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Multiple-Switch-Board Systems, (Case 176,) 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 that class of multiple-switch-board circuits in which metallic telephone-lines and single-circuit or grounded lines are connected with the same exchange.

In my Case 175, filed October 15, 1888, Serial No. 288,140, I have described and claimed operator's apparatus and circuits, so arranged as to avoid the effects of induced currents from other circuits in connection with a uniform test for all the lines. When two lines are looped together in metallic circuit, the opposite sides of the metallic circuit thus formed are connected to ground on one side through a self-induction coil and on the other side through a self-induction coil and test-battery. In my said case, however, I found it necessary to provide a special plug for making the tests, since the regular connecting-plug of each pair could not be used for testing in case a metallic-circuit subscriber called for a single-circuit subscriber, as in such case there would be a false signal resulting from the circuits connected with the test-battery.

My invention herein is designed to avoid the necessity of using a special test-plug. This I accomplish by means of a condenser placed in the circuit of the operator's telephone-set and a proper switching device. The telephone-circuits and the subscribers' outfits may be the same as illustrated in said prior application, and a self-induction device corresponding in capacity to that of the telephone proper may be used to preserve the balance when the telephone is connected with the circuit. The different strands of the connecting-cords are also connected each through different self-induction coils to ground, and a test-battery which may be common to a large number of cords is provided in one of

said branch ground connections, the same as described in my prior application.

The loop-switch which I preferably employ is of special construction, and the circuits connected therewith are so arranged in connection with the condenser that one loop-plug of a pair may be used for answering any subscriber's call, while the other loop-plug of the pair may be used in testing the line called for and in making the connection therewith. The loop-plug of a pair which is connected with the calling subscriber's line is sometimes spoken of as the "answering-plug," while the other plug—that is, the one used to connect with the called subscriber's line—is sometimes termed the "connecting-plug." It is the connecting-plug that I use in testing the line called for.

When the operator's telephone-set is switched into circuit of any pair of cords by means of the cam-lever, the condenser is brought in the strand connecting the tips of the cords—that is to say, in the strand which connects together the terminals of the two plugs, which are designed to be connected with the springs, respectively, of the spring-jack switches of any two lines with which they are connected. When the answering-plug is inserted to connect with any calling subscriber's line, a circuit is formed from the test-battery to the sleeve of said plug, and thence connection is made with the several test-pieces of the line, and thence the circuit may be traced over the limb of the metallic circuit connecting with said test-pieces to the subscriber's station, and thence back over the other limb of the metallic circuit to the spring of the switch in which the plug is inserted, and thence to the tip of the plug, and thence through the condenser to the tip of the answering-plug of the pair. The condenser being charged by the test-battery, when the connection is first made the test-battery will be shut off from the tip of the connecting-plug at the condenser. Voice-currents may, however, be sent through the condenser. Thus, by throwing the loop-key in proper position the operator's telephone will be brought into circuit with the calling subscriber and the order of the calling subscriber may be re-

ceived by the operator. The operator having received the order at once applies the tip of the connecting-plug to the test-piece of the line called for. As before stated, the test-battery with respect to the circuit of the calling subscriber's line is shut off from the tip of the connecting-plug at the condenser. Therefore if there be no current present from some other source at the test-piece to which the tip of the plug is applied, there will be no sound heard in the operator's telephone when thus connected therewith, for the reason that the operator's telephone is connected with the strand of the cord which connects to the tip of the connecting-plug at a point between the condenser and the said strand, even though the line tested were a single-wire circuit having its test-pieces connected together and through resistance to ground. Therefore the operator making the test and hearing no sound will know that the line is free. On the other hand, if the operator hears a click in her telephone when the test is made she will know that battery is connected with the test-circuit of the line called for, and this will indicate that the line is busy.

My invention is illustrated in the accompanying drawings, in which Figure 1 is a diagram illustrative of three telephone-lines—two metallic and one single—connected with three different switch-boards at the central office in connection with the operator's apparatus and circuits at two of the boards embodying my invention. Fig. 2 is a detail view of the circuits of a single pair of cords, the springs and contacts of the loop-switch connected therewith being shown in perspective. Figs. 3 and 4 are elevations of the different sides of the cam-lever loop-switch in detail.

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

I will first describe the operator's apparatus, as illustrated in Figs. 2, 3, and 4. The answering loop-plug *a* is shown inserted in a switch. The other plug *b* of the pair is shown with its pair touching a test-piece as in the act of testing. The circuit between the tip of the plugs *b* and *a* may be traced as follows: From the tip of the plug *b* by strand *c* to calling-key *d*, thence to contact *e* and spring *f* of the switch, thence through the condenser *g* to contact *h* of the switch, and thence to spring *i* of the switch, and thence to the other calling-key *k*, and thence to the tip of plug *a*. The circuit between the sleeves of the plugs may be traced directly by strand *l*. The ground branch *m* is permanently connected through a self-induction coil with the strand *c*, while the branch *n* is permanently connected with the strand *l* through a self-induction coil and test-battery *o*. Between the condenser *g* and the spring *f* of the switch a ground circuit or branch is provided, which passes through the operator's telephone, thus connecting the telephone with the strand *c*

when the switch is in the position shown. From the strand *l* a branch *p* connects with the contact *p'* and spring *p²* of the switch, spring *p²* being permanently connected with a self-induction device *p³*, included in a ground circuit. When the telephone is connected with strand *c*, the corresponding self-induction device *p³* or "dummy telephone-set," as it has been sometimes called, is connected in a similar manner with the strand *l*. When the lever *q* of the switch is thrown down, the connections of the springs are changed, the springs *f* and *p²* being separated from their contacts *e* and *p'*, respectively, while spring *i* is at the same time disconnected from its contact *h* and closed to its lower contact *q'*. In this manner the telephone, as well as the corresponding dummy set, may be disconnected from the strands of the cord and the portion of the operator's telephone-circuit containing condenser *g* cut out, the circuit of cord *c*, however, being completed through the clearing-out shutter *q²*, contact *q'*, and spring *i* direct. Thus when the lever is thrown down we have direct circuits through the strands of the cords, the cord *l* being, however, provided with the ground connection *n* through the self-induction coil and test-battery *o*, while the other cord *c* is provided with the connection *m* through a similar self-induction coil. The calling-keys *d k* are of the usual construction. By depressing key *d* current will be sent over the circuit connected with the tip or plug *b*, while on depressing key *k* current will be sent from the generator over the circuit with which the tip of plug *a* may be connected. It will be seen that the switching device, operated by lever *q*, consists of three springs *f i p²*. The cam at the lower end of lever *q* is placed in position to force the springs *f* and *p²* away from contacts *e* and *p'*, respectively, and at the same time separate spring *i* from contact *h* and close the same upon contact *q'*, when the lever is thrown forward. When the lever is up, the springs, by their own tension, are brought to the positions shown in Figs. 2, 3, and 4.

Referring now to Fig. 1, it will be seen that telephone-line *r* extends in two branches or limbs to the central office, the limb *r'* being connected through the springs of the switches *r² r³ r⁴* on the different boards, and from the contact of the switch *r⁴* through the individual annunciator *r⁵* to ground. Limb *r⁶* is connected with the frames or test-pieces of said switches *r² r³ r⁴*. The single-wire circuit *r⁷* extends from the subscriber's station thereof through the springs and contacts of the switches *r⁸ r⁹ r¹⁰*, and from the contact of switch *r¹⁰* through the individual annunciator *r¹¹* to ground. The rings or test-pieces of switches *r⁸ r⁹ r¹⁰* are permanently connected together by test-wire *r¹²*. Said test-wire *S*, instead of extending back to subscriber's station, as is the case with respect to metallic circuits, is connected directly to ground through resistance *r¹³*. The metallic circuit *r¹⁴* extends

from the subscriber's station thereof in two branches through switches r^{15} , r^{16} , and r^{17} the same as described with respect to metallic circuit r , the individual annunciator r^{18} being included in the limb or branch which passes through the springs and contacts of the switches. The operator's apparatus at the last board I have lettered to correspond with the lettering of Fig. 2. Similar apparatus is provided at the first board, the pair of plugs a' b' being shown inserted in spring-jacks r^2 r^8 , respectively, to switch the telephone-lines r r^7 together. The cam-lever s is thrown up and the operator's telephone at the first board is disconnected from the united circuits of the two lines, while the clearing-out annunciator s' is included in the circuit. The test-battery o is connected to the strand l' , which connects together the sleeves of the plugs a' b' . The resistance r^{13} in the test-circuit r^{12} is so great that only a small amount of current will pass from the battery o to ground through said resistance r^{13} . We will suppose that when two wires are thus connected upon one board one of the connected lines is called for at another board—as, for example, at the last board. Let the signal be sent in over metallic circuit r^{14} to throw down the shutter r^{18} at the last board, as shown. The operator, seeing the shutter of annunciator r^{18} fall, inserts answering-plug a into the spring-jack r^{17} , and, throwing down the lever q , brings her telephone into circuit and is in position to receive the order. The order being received, we will say for connection with line r , said line r is tested by means of the connecting-plug b applied to the test-piece of switch r^4 , as shown. As line r is already connected at another board, the test-battery o will be closed to the tip of plug b when applied to the tip of the frame of switch r^4 , and the operator, listening at her telephone, will hear the sound which is due to the closing of the circuit. The circuit thus formed may be traced from battery o to the strand l' of the cords at the first board and thence to the sleeve of the plug a' , thence to the frame of switch r^2 , and thence to the frame of switch r^4 , thence to the tip of plug b , thence to the strand c , connecting the tips of the cords, and thence through contact e and spring f of the switch, and thence through the operator's telephone to ground. The operator, listening at the telephone and hearing the sound, will know that the line tested is busy. Suppose the single-wire circuit r^7 were asked for instead of the metallic circuit r . In this case the test would be made at switch r^{10} , and the circuit thus formed from the test-battery might be traced to strand l' of the cords at the first board, thence to the sleeve of plug r^{10} , and thence to the tip of plug b , and thence through the strand c to key k , thence to contact e , spring f , and the telephone to ground. If the condenser g were not included in the circuit, a false signal would be heard in the operator's telephone on testing an idle single-circuit telephone-line, as circuit r^7 . Thus, as

shown at the last board, the answering-plug a is inserted in spring-jack switch r^{17} . Tracing from battery o , the circuit is complete to the sleeve of plug a , thence to the frame of switch r^{17} , and thence over circuit r^{14} through the subscriber's station and back to the spring of switch r^{17} , thence to the tip of plug a , thence to spring i of the switch and contact h , and thence through the telephone to ground. Thus, omitting the condenser, a complete circuit is formed from battery o through the operator's telephone. Now on applying the tip of the connecting-plug b to the frame of a switch r^{10} of a single-circuit line, a third leg or half-connection would be formed to ground through resistance r^{13} . The closing of this branch to ground would change the electrical condition of the telephone and cause a sound therein which could not be distinguished from a true busy-signal. Thus without the condenser there would be no sure means of determining whether a single line called for by a metallic-circuit subscriber was busy.

In my prior application an extra test-plug is provided and the condenser is not used.

Each operator may have, say, fifteen pairs of connecting-cords, and consequently fifteen switches. Of those switches the different springs f are connected together and to the ground branch, including the operator's telephone. Spring i is connected only to its particular strand of a pair of cords. These contacts of all of each operator's switches, whatever the number may be, are connected together and to the wire connecting with one side of the condenser, as shown. Springs p^2 of these switches are connected together and to the ground branch, including the dummy telephone-set p^3 . Thus it will be seen that only one condenser is required for each operator's outfit.

My invention admits of various modifications, which would readily suggest themselves to those skilled in the art, and I therefore do not limit my invention to the construction shown.

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

1. The combination, with a metallic-circuit telephone-line connected with switches on two or more switch-boards, one branch of said metallic circuit being normally open at the central office and the other branch being normally connected through an individual annunciator to ground, of a single-wire circuit connected with switches, one on each of the switch-boards, and through an annunciator to ground, the frames or test-pieces of the switches of said single line being connected together and through resistance to ground, and operator's apparatus consisting of a pair of loop-plugs and the cords connected therewith, one strand of said cord being connected with a ground branch containing a self-induction coil and extending from the connection with said branch through one spring and contact of a switching

device, thence through a condenser to another ground branch containing a telephone, and thence through another spring and contact of said switching device, the other strand of said pair of cords being connected with a ground branch including a test-battery and self-induction coil, whereby the two telephone-lines may be tested and connected together, substantially as and for the purpose specified.

2. The combination, with a metallic-circuit telephone-line connected with switches on two or more switch-boards, one branch of said metallic circuit being normally open at the central office and the other branch being normally connected through an individual annunciator to ground, of a single-wire circuit connected with switches, one on each of the switch-boards, and through an annunciator to ground, the frames or test-pieces of the switches of said single line being connected together and through resistance to ground, and operator's connecting, switching, and testing apparatus, whereby the two telephone-lines may be tested and connected together, substantially as and for the purpose specified.

3. A metallic circuit with the answering-plug of a pair inserted in a spring-jack switch of the line upon one of two or more switch-

boards with which the line is connected, the single-circuit line connected with the same switch-boards, the frames or test-pieces of the switches of said single-circuit line being connected together and through resistance to ground, the answering-plug of said pair being applied to the ring or test-piece of the switch of the single-circuit line on the same board with the switch of the metallic circuit in which the answering-plug is inserted, a test-battery connected with the strand of the cords which unites the sleeves of the plugs, a condenser included in the circuit of the other strand of the cords, and a telephone in a ground branch connected with said strand, the connection with the telephone being on the side of the condenser nearest the connecting-plug, whereby current from the test-battery is prevented from passing through the test-circuit of the single line to ground, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 17th day of November, A. D. 1888.

CHARLES E. SCRIBNER.

Witnesses:

GEORGE P. BARTON,
ELLA EDLER.