

(No Model.)

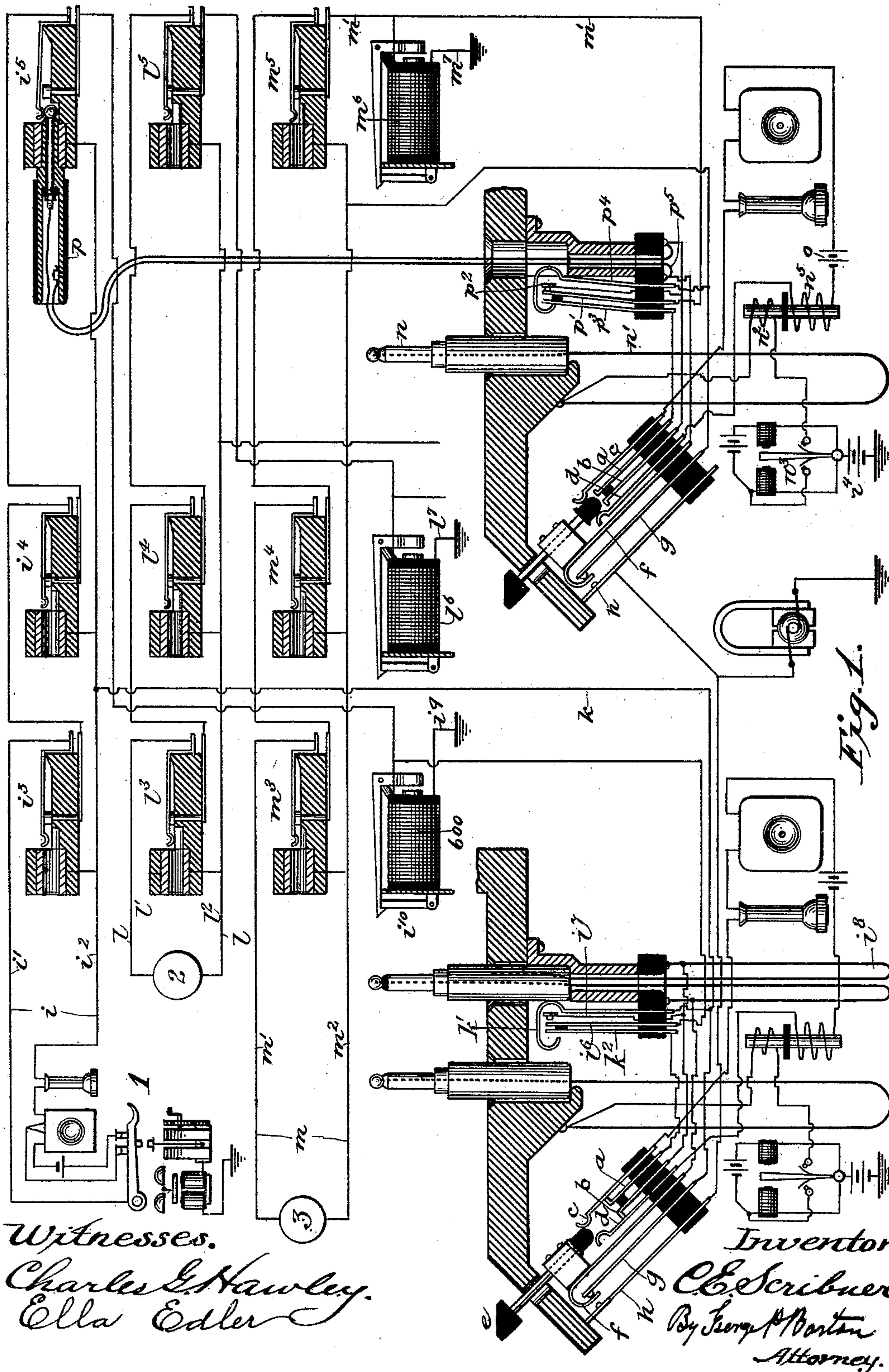
C. E. SCRIBNER.

2 Sheets—Sheet 1.

TESTING APPARATUS FOR MULTIPLE SWITCHBOARD SYSTEMS.

No. 496,907.

Patented May 9, 1893.



(No Model.)

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2 Sheets—Sheet 2.

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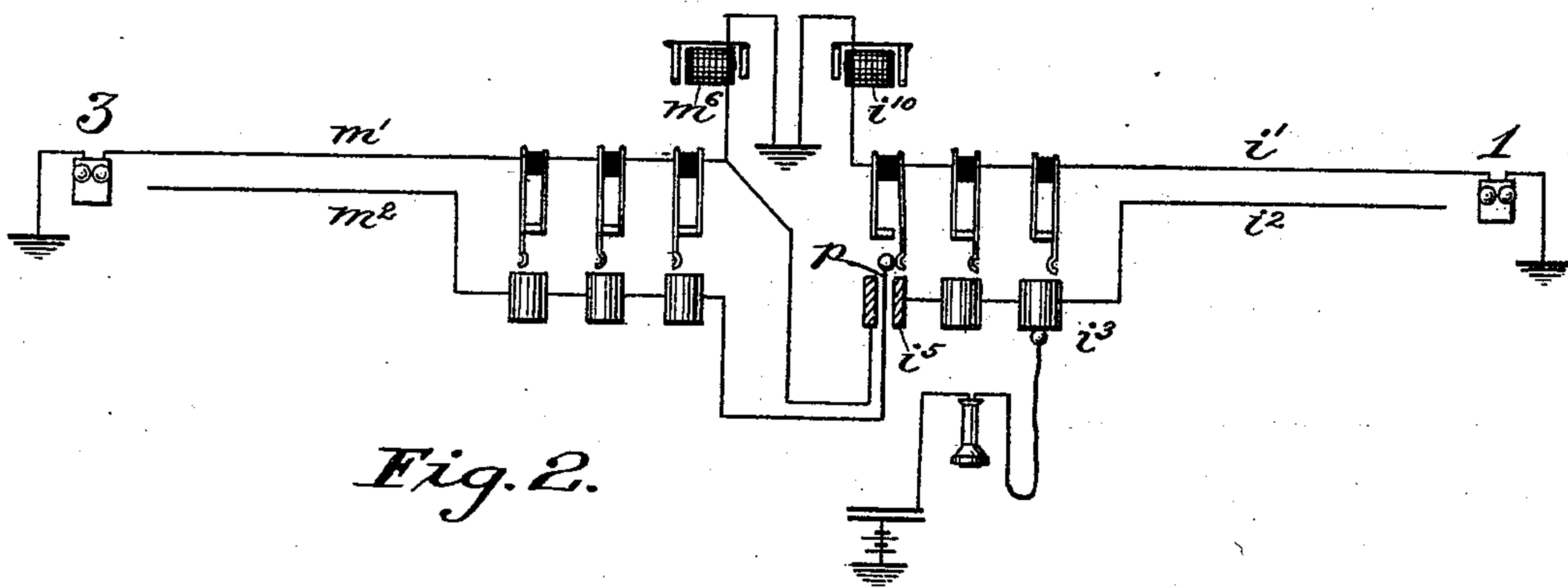


Fig. 2.

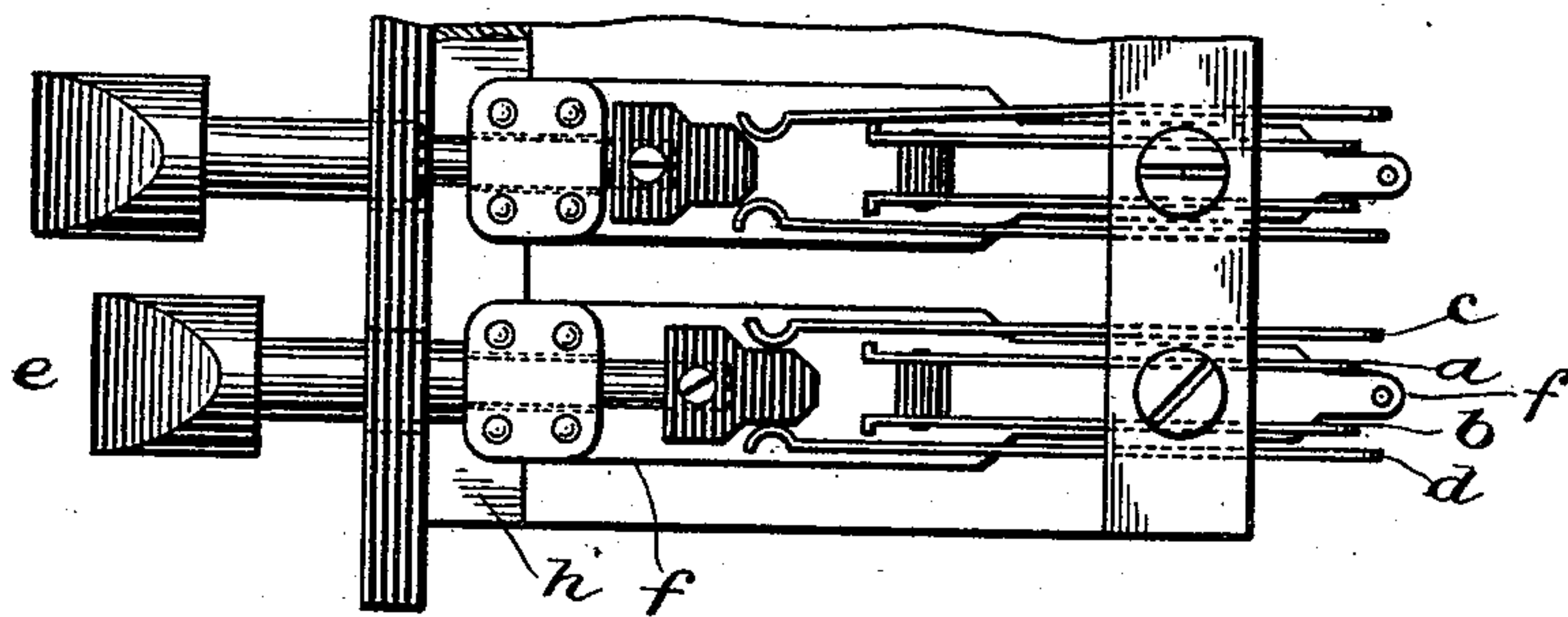


Fig. 3.

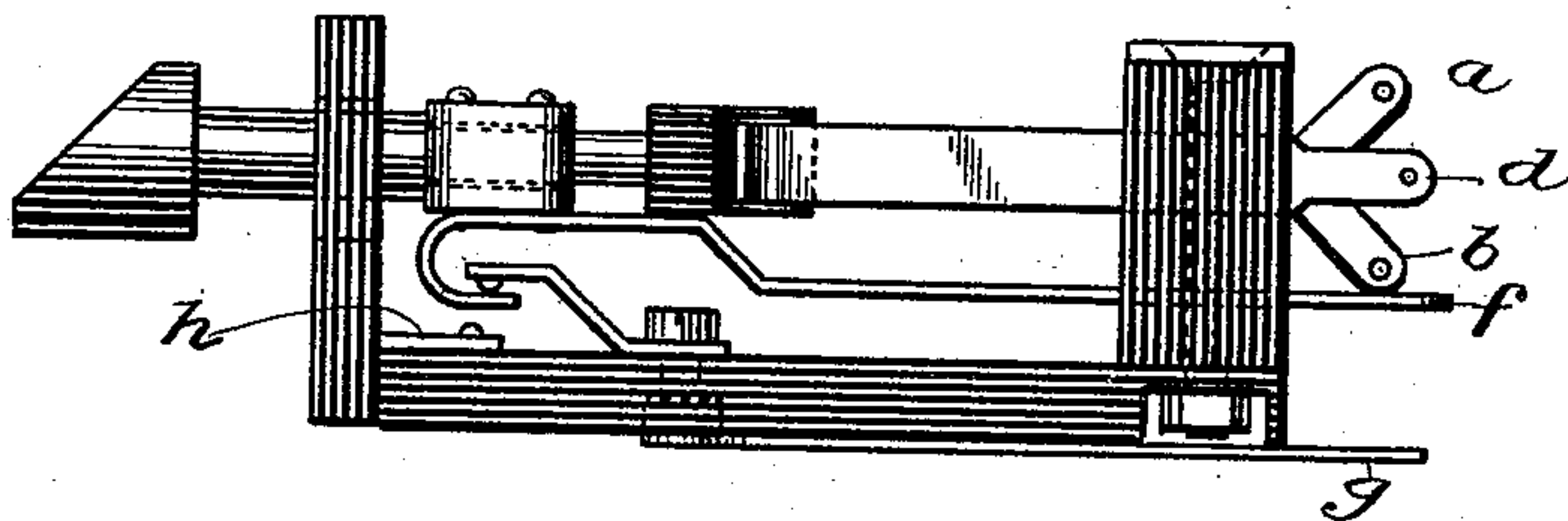


Fig. 4.

Witnesses.  
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# UNITED STATES PATENT OFFICE.

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## TESTING APPARATUS FOR MULTIPLE-SWITCHBOARD SYSTEMS.

SPECIFICATION forming part of Letters Patent No. 496,907, dated May 9, 1893.

Application filed March 24, 1890. Serial No. 345,039. (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 Testing Apparatus for Multiple-Switchboard Systems, (Case No. 224,) 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.

The object of my invention is to provide ready means of doing the operator's work at the telephone exchange office of a multiple switch board system.

The features of my invention may be stated as consisting—

First. The telephone lines are arranged so that when connected in metallic circuit through the central office the different limbs of the two circuits will be reciprocally united, one with another, that is to say, the limb of one circuit which includes the springs and contacts of its switches will be connected with that limb of the other circuit which connects with the test pieces of its switches in order that the lines may test busy when thus connected together, although the subscribers may have hung up their telephones.

Second. The telephone lines are connected in metallic circuit with the different switch boards, the limb of each circuit which connects with the springs and test pieces being normally grounded through the subscriber's bell, that is, when the subscriber's telephone is hung up, and the other limb being normally open at the subscriber's station, the limb which is normally grounded being permanently connected through the high resistance individual annunciator of the line at the central office. Each line is provided with a terminal loop plug and cord and a cord switch and a listening and calling key and the sleeve of the plug is connected with that limb of its telephone line which passes through the springs and contacts of the switches thereof so that when the terminal plug of one line is inserted in the spring jack switch of another line the opposite corresponding limbs of the two circuits will be reciprocally connected together, that is to say, that limb of the circuit

connecting with the sleeve of the plug will be connected with the test portion of the other line while the test portion of the first line which is connected to the tip of the plug will be connected through the medium of the tip of the plug with the limb of the other line which extends to the spring of the switch in which the plug has been inserted.

Third. When air lines are used of moderate length so that their capacity is only moderate the loop plug of a line may be used in testing another line; when, however, the circuits are of considerable length and run in cables making their condenser capacity considerable I preferably use a special test plug connected in a circuit leading to ground through a buzzer and battery so arranged that a line when tested will be charged by the battery and buzzer without causing a click in the operator's telephone connected in circuit with the buzzer. The loop plugs may always be employed in making a test required; in case the lines tested are of high capacity one or two taps or applications of the tip of the plug to the test piece will charge the line, the sounds caused in the telephone at such times being disregarded.

Fourth. In connecting the test rings of connected lines with ground to make them test busy by alternating the connection from the test rings to the limb connecting through the annunciator to ground when the telephones are off the hook and through the subscriber's outfits to ground when the telephones are on the hook.

My invention will be readily understood by reference to the accompanying drawings, in which—

Figure 1 is a diagram illustrative of the circuits of three telephone lines connected with three switch boards with the operators' outfits at two of the boards, the subscriber's apparatus at one station only being illustrated in detail. Fig. 2 is an illustrative diagram of two connected lines, the telephones of the stations being hung up with testing apparatus applied to a test piece of one of the lines. Fig. 3 is a plan view of two listening and calling keys mounted upon the same strip. Fig. 4 is a side elevation thereof.

The listening and calling key as shown in



Figs. 3 and 4 consists in cord or line contacts  $a\ b$ , the telephone springs  $c\ d$ , the plunger  $e$ , the spring  $f$  carrying the guide on which the plunger is mounted, the contact  $g$  against which spring  $f$  normally rests and the generator contact  $h$  against which spring  $f$  is closed when the handle of the plunger is depressed. When the plunger is forced in between springs  $c\ d$  these telephone springs  $c\ d$  will be disconnected from the line contacts  $a\ b$  respectively, the tension of these springs  $c\ d$  being such that when the plunger is withdrawn these springs  $c\ d$  will rest upon said contacts  $a\ b$ . By simply pressing down upon the handle of the plunger the spring  $f$  will be separated from its contact  $g$  and closed upon generator contact  $h$ . Such a listening and calling key having been described and claimed in a prior application forms no part of my invention herein, except as used in connection with the special circuits herein shown.

Telephone line  $i$  extends in two limbs or branches  $i'\ i^2$  to the central office, limb  $i'$  being connected through the spring and contact of each of the switches  $i^3\ i^4\ i^5$  as shown in Fig. 1, and from the contact of the switch  $i^5$ , on the last board to contact  $i^6$  of the cord switch and thence when the plug of the cord switch is removed from its socket to contact  $i^7$  of the cord switch and thence to the strand  $i^8$  of the cord, said strand  $i^8$  being connected with the sleeve of the plug. It should be observed that the contact  $i^7$  of the cord switch is provided with a connection to the telephone contact  $b$  and spring  $d$  of the listening and calling key. A ground branch  $i^9$  is permanently connected with the limb  $i'$  and in this branch  $i^9$  is permanently included the subscriber's individual annunciator  $i^{10}$ ; this individual annunciator is constructed to act as a retardation coil and should be of high resistance, say six hundred ohms. The other limb  $i^2$  which is the test portion or limb of the circuit will be normally open both at the subscriber's station and at the central office; a branch  $k$  from this limb  $i^2$  extends to the strand of the cord connecting with the tip thereof; this branch  $k$  including in its circuit the spring  $f$  and contact  $g$  and being provided with a connection through springs  $k'\ k^2$  to the contact  $a$  of the listening and calling key.

The subscriber's outfit is of usual construction consisting of a bell and generator in a ground branch normally closed to limb  $i'$  as will be shown at station 1, Fig. 1, when the telephone is on the switch, the limb  $i^2$  being then open; on removing the telephone from the switch the ground branch containing the bell and generator is opened as shown at said station 1 and the limbs  $i'\ i^2$  united in metallic circuit through the subscriber's telephone. The telephone circuit  $l$  of sub-station 2 extends in a similar manner by limbs  $l'\ l^2$  to the switches  $l^3\ l^4\ l^5$ , the individual annunciator  $l^6$  being included in a ground branch  $l^7$ . The subscriber's outfit at board 2 and the connec-

tions of line  $l$  with its cord switch and listening and calling key are not shown. Sub-station 3 is connected by circuit  $m$  in the same manner by limbs  $m'$  and  $m^2$  with switches  $m^3\ m^4\ m^5$  and at board 3 with its individual annunciator  $m^6$  in ground branch  $m^7$ , cord switch, plug and listening and calling key being of the construction described with respect to line  $i$ .

I have shown in connection with the subscriber's outfit at each of the boards 1 and 3 a test plug forming the terminal of a ground branch including a connection with the operator's telephone and a battery, together with a buzzer or rheotome. Thus as shown at board 3 the plug  $n$  is connected with the flexible cord  $n'$  and thence through one coil  $n^2$  of the converter and thence through the contacts of the rheotome  $n^3$  and thence through battery  $n^4$  to ground. The other coil  $n^5$  of the converter is included in the local circuit of the telephone, this being a convenient and well known way of connecting a test circuit with an operator's telephone. A battery  $o$  may be included also in the local circuit of the telephone, this local battery serving as a test battery when the loop plug of a line is used in making a test; the central office ground for this test battery  $o$  when such test is made being formed through the ground connection of the individual annunciator of the line whose plug is used in making the test.

Suppose now that telephone line  $i$  is in its normal condition, that is, the telephone of station 1 on the switch and the limb  $i^2$  open at both ends; in such case the condenser capacity of said limb  $i^2$  will depend upon certain well known conditions, that is to say, upon its length and distance from the ground; if run in a cable for a considerable distance its capacity would be such that if a branch containing a battery and telephone is connected therewith the current from the battery in charging the line might cause a click in the telephone; if, however, the limb  $i^2$  is an air line of moderate length its condenser capacity may be disregarded as it will not be sufficient to cause a flow of current sufficient to produce a click or sound in the telephone. Now when one telephone line is connected with another at the central office there will be an intersection of the circuits; thus terminal loop plug  $p$  of line  $m$  is shown inserted in spring jack switch  $i^5$ . Now the limb  $m'$  of line  $m$  being connected with the sleeve of said plug  $p$  and the limb  $m^2$  being connected with the tip thereof it follows that the united circuit of the two telephone lines thus formed will result in the circuits intersecting each other, that is to say, the limb  $m'$  of line  $m$  will be connected with limb  $i^2$  of line  $i$ , while limb  $m^2$  of line  $m$  will be connected with limb  $i'$  of line  $i$ . The connection of limb  $i'$  with individual annunciator  $i^{10}$  will be broken at switch  $i^5$  while the individual annunciator  $m^6$  of line  $m$  will be left in its ground branch  $m^7$  to serve as a clearing out annunciator. By this ar-



rangement of the circuits when two lines are  
 connected together the test portion of one line  
 will be connected to the spring portion of the  
 other line and thence to the subscriber's sta-  
 5 tion and either through his outfit to ground  
 or through his return line to the central office  
 and through his annunciator to ground. That  
 is to say, suppose both subscribers thus con-  
 nected, that is, subscribers 1 and 3 should  
 10 hang up their telephones so as to open the  
 outer ends of limbs  $i^2 m^2$ ; it will be observed  
 that since the lines intersect each other the  
 lines will both test busy although the tele-  
 phones have been thus hung up since the test  
 15 circuit applied to the test portion of one line  
 will find a ground connection at the subscrib-  
 er's station of the line  $m$ . This will be most  
 clearly understood by reference to the dia-  
 gram in which the limbs  $i^2 m^2$  are shown open  
 20 at the subscribers' stations 1 and 3 and the  
 test is shown applied to the switch  $i^3$  of line  $i$ .  
 This limb  $i^2$  being connected with limb  $m'$  the  
 test battery in the test circuit will find the  
 circuit over limb  $m'$  to ground at station 3.  
 25 In case the loop plug, as for example plug  $p$   
 of line  $m$ , be used in making the test the test  
 circuit will be from the ground branch in-  
 cluding the annunciator, that is, branch  $m^7$   
 through the annunciator  $m^6$  to branch  $m'$  and  
 30 thence through the contacts  $p' p^2$  of the cord  
 switch and thence to the contact  $b$  and spring  
 $d$  of the listening key and thence through the  
 battery  $o$  and the telephone to spring  $c$  of the  
 listening key and thence to contact  $a$  and  
 35 thence through the springs  $p^3 p^4$  and thence  
 through contacts  $g f$  of the calling key to the  
 strand  $p^5$  of the cord of plug  $p$ , said strand  $p^5$   
 being connected with the tip thereof. Now  
 by tapping the plug  $p$  a few times to the test  
 40 piece of any line and listening at the tele-  
 phone included in the circuit thereof it may  
 be determined whether the line is in use, no  
 matter whether the line be of high capacity  
 or low capacity, for upon so tapping the test  
 45 piece, if the test piece be connected with  
 ground, it will be evident by the series of clicks  
 which the operator will hear in her telephone;  
 if it is not connected with ground, although  
 the operator may hear one or two clicks as  
 50 the line charges, the third touch will give no  
 sound in her telephone. The test piece, as  
 before stated, will always be grounded when  
 it is connected with another line either  
 through a subscriber's set to ground or  
 55 through a clearing out annunciator to ground.  
 By using the special test plug  $n$ , however, in  
 the battery circuit of which is included the  
 rheotome and telephone, any false signal in  
 the telephone will be prevented as the test  
 60 will be a tone or buzz for a busy line and the  
 absence of tone or buzz for a line that is not  
 busy, and although the operator may hear  
 a click as she touches the special test plug to  
 a test ring there will be no tone in her tele-  
 65 phone.

Suppose subscriber of station 3 wishes con-

nection with subscriber of station 1; he first  
 operates his generator thereby throwing down  
 annunciator  $m^6$ ; the operator at board 3 see-  
 ing the shutter fall raises plug  $p$ , bringing 70  
 her telephone into circuit; she then makes  
 the test either by means of said plug  $p$  or by  
 plug  $n$  as may be most convenient. The test  
 will be made by touching the tip of the plug,  
 whichever is used, to the test piece of switch 75  
 $i^5$  of line  $i$ . We will suppose first that plug  $p$   
 is used and of course the plunger of the lis-  
 tening key will be out so that the spring  $c$   
 will rest on contact  $a$  and spring  $d$  upon con-  
 tact  $b$ . The circuit thus formed will be from 80  
 ground by branch  $m^7$  to limb  $m'$  and thence  
 through contact  $p' p^2$  of the cord switch to  
 contact  $b$  and spring  $d$  of the listening key  
 and thence through battery  $o$  and the opera-  
 tor's telephone to spring  $c$  and contact  $a$  and 85  
 thence by springs  $p^3 p^4$  of the cord switch to  
 contact  $g$  and spring  $f$  of the calling key and  
 thence to strand  $p^5$  of the cord of plug  $p$ , said  
 strand  $p^5$  connecting with the tip thereof.  
 Now if the line  $i$  is free the test piece of switch 90  
 $i^5$  will be disconnected from ground and hence  
 the circuit of battery  $o$  will be opened at the  
 test or return portion  $i$ . The operator there-  
 fore hearing no click in her telephone will  
 know that the line  $i$  is free and will thereupon 95  
 insert the plug  $p$  into switch  $i^5$  as shown.  
 Depressing the handle of the calling key  
 sends generator current over limb  $i'$  to ring  
 the subscriber's bell at station 1; the sub-  
 scriber at station 1 will thereupon take down 100  
 his telephone and the two subscribers will be  
 connected as shown in Figs. 1 and 2. The  
 plunger of the listening key will be inserted  
 as shown between springs  $c d$  to disconnect  
 the telephone and the annunciator  $m^6$  will be 105  
 left in a ground branch to serve as a clearing  
 out signal device. Suppose, however, the con-  
 denser capacity of limb  $i^2$  were considerable  
 then it would be desirable to use the special  
 test plug  $n$  in connection with the rheotome 110  
 and battery  $n^4$ ; if on applying tip of plug  $n$   
 to the test piece of switch  $i^5$  a tone is heard  
 in the telephone of the operator it will be no-  
 tice that the limb  $i^2$  is provided with a ground  
 connection, that is, that the line  $i$  is busy; if, 115  
 however, no tone is heard it will be notice  
 that the line is free and the operator will pro-  
 ceed to make the connection by inserting plug  
 $p$  as before described.

In case the special test plug as  $n$  be relied 120  
 upon in making the test it will not be neces-  
 sary to include a battery  $o$  in the circuit of  
 the operator's telephone.

My invention admits of various modifica-  
 tions which would readily suggest themselves 125  
 to those skilled in the art and I therefore do  
 not limit myself to the details of construc-  
 tion shown. There are, however, certain  
 broad or general features of the system ex-  
 emplified herein, which are described and 130  
 claimed in my application, Serial No. 339,597,  
 filed February 7, 1890, for multiple switch



board apparatus. I therefore limit my patent in this case to the combinations hereinafter set forth.

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

1. Two telephone lines connected in metallic circuit through the central office, the different limbs of the two circuits being reciprocally united one with another, that is, the return or test limb of each being united at the central office with the opposite limb of the other, a ground branch including an individual annunciator of high resistance constructed to act as a retardation coil, in combination with the switches at the subscriber's station, whereby on hanging up the telephone the return portions of said telephone lines will be grounded respectively at the subscriber's station of the other line, substantially as and for the purpose specified.

2. A telephone line provided at the subscriber's station thereof with a switch operated by the telephone, a normally closed ground branch including the bell and generator said line extending in two branches to switches on different switch boards, the branch which is normally grounded at the subscriber's station being provided with a permanently closed ground branch including an individual annunciator at the central office, in combination with a terminal loop plug and cord for said line, a cord switch and a listening and calling key and the operator's telephone, substantially as and for the purpose specified.

3. The combination with telephone lines connected in metallic circuit with the differ-

ent switch boards, the limbs of each circuit which connect with the springs being grounded through the subscriber's bell when the subscriber's telephone is hung upon the switch and the other limb being normally open at the subscriber's station, of a different ground branch for each line including the individual annunciator thereof, the terminal loop plug and cord, the cord switch and listening and calling key of each line, the sleeve of the terminal plug of each line being connected with that limb of its telephone line which passes through the springs and contacts of the switches thereof, whereby when one line is connected with another by insertion of the loop plug into a switch of the other the opposite corresponding limbs of the two circuits will be reciprocally connected together, substantially as and for the purpose specified.

4. The loop terminal plug of a telephone line and its cord, the strand of the cord connecting with the tip thereof being provided with a connection through a battery, the operator's telephone and a ground branch including the high resistance individual annunciator of the line, in combination with the test portion of a line to be tested, said test portion being either open or grounded accordingly as the line is free or busy, substantially as and for the purpose specified.

In witness whereof I hereunto subscribe my name this 25th day of February, A. D. 1890.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,  
GEORGE P. BARTON,