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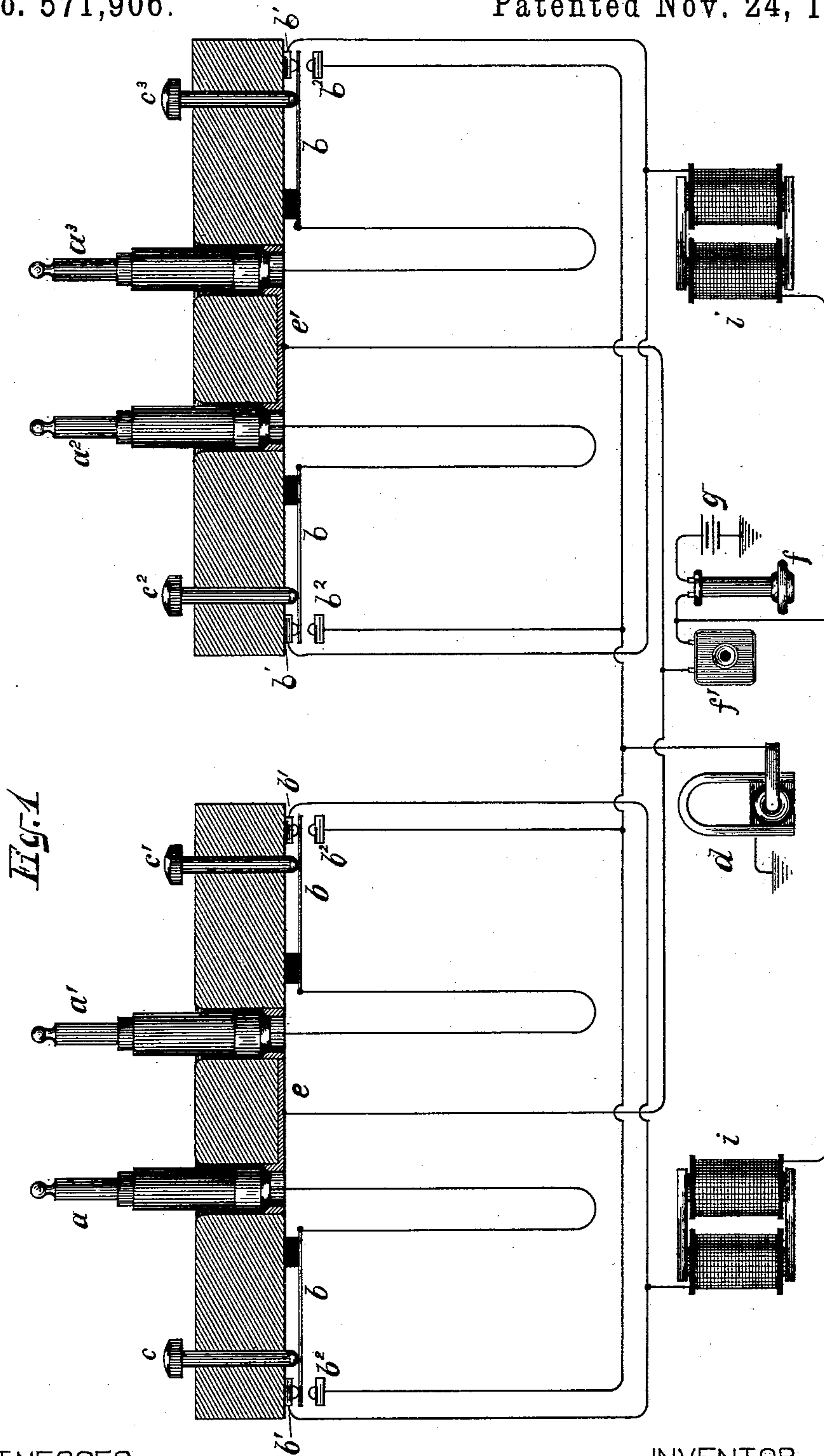
2 Sheets—Sheet 1.

C. E. SCRIBNER.

APPARATUS FOR MULTIPLE SWITCHBOARDS FOR TELEPHONE EXCHANGES.

No. 571,906.

Patented Nov. 24, 1896.



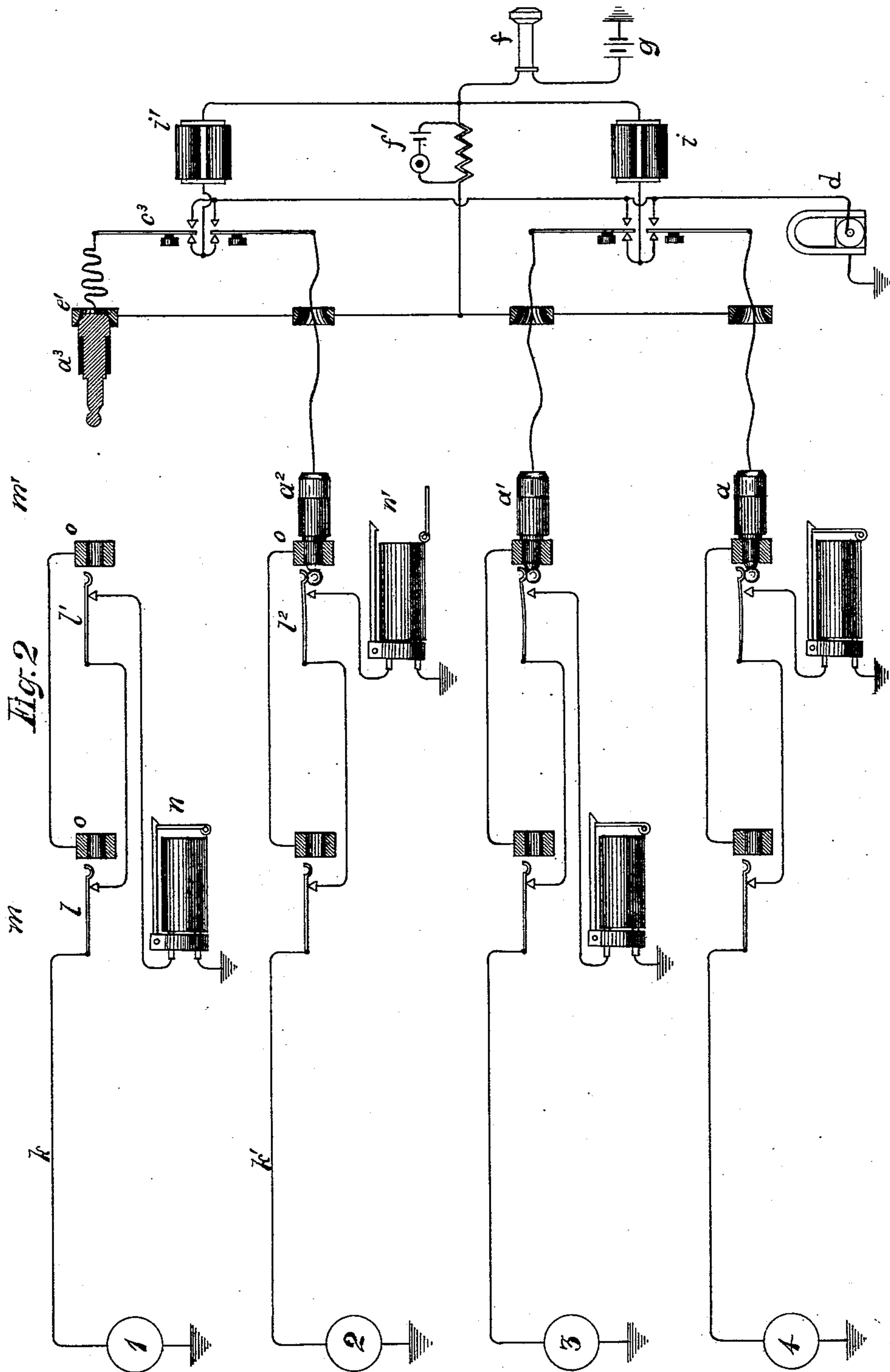
WITNESSES  
Ella Edler.  
Lucile Russell.

INVENTOR  
Charles E. Scribner  
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By *F. R. McBerty* Att'y



# UNITED STATES PATENT OFFICE.

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

APPARATUS FOR MULTIPLE SWITCHBOARDS FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 571,906, dated November 24, 1896.

Application filed February 7, 1893. Serial No. 461,387. (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 Apparatus for Multiple Switchboards of Telephone-Exchanges, (Case No. 317,) 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 apparatus for operators of telephone-exchange central stations. Speaking in a general manner, its object is to facilitate the work of establishing connection between the lines in the central office, enabling the operators to effect connections between lines more quickly and hence enabling each operator to attend to a greater number of calls than heretofore.

In telephone-exchange systems of the type most largely in use each telephone-line extends from its particular substation to a central station or office and is connected thereat with one or more sockets upon different switchboards and with a signaling device upon some one of the switchboards. At each switchboard are stationed one or more attendants, each of whom is provided with several metallic plugs constructed to fit the line-sockets or spring-jacks and to make electrical connection with them, the plugs being connected in pairs by electrical conductors. Thus by inserting one connecting-plug of a pair into the socket or spring-jack of one line and the other plug of the pair into the socket of another line an operator is enabled to connect two telephone-lines into a continuous circuit, including the telephone apparatus at both substations. In order that any subscriber may communicate with an attendant operator at the central station to give an order for the connection of his line with some other line, each operator is furnished with a telephone set and with means for connecting her telephone set with any pair of connecting-plugs. Heretofore various switches and keys have been employed for thus connecting the operator's telephone with a pair of plugs. An operator upon seeing the indication of

the signaling device belonging to any telephone-line inserts one plug of a pair into a socket of the line and throws the corresponding key into position to connect her telephone with that pair of plugs. Having received the order, she disconnects her telephone from the line by means of the same key.

In multiple-switchboard systems each line is connected with a spring-jack upon each of several different switchboards, and means are provided by which an operator at any switchboard may determine whether a connection has already been made to any particular line at some other switchboard. Commonly normally-insulated contact-pieces are provided in exposed positions, one near each spring-jack of each line, all the contact-pieces belonging to one line being connected together, and the connecting-plugs are arranged to cross together the normally-insulated contact-piece and the line contact-pieces of the jack into which it may be inserted, whereby the normally-insulated contact-pieces of that line are all connected to earth.

An operator at another switchboard desiring to know whether a line for which she has received a call is in use or not tests the condition of the normally-insulated contact-pieces of the line by applying to the one of them which is located upon her switchboard the tip of a testing-plug which is connected to earth by a branch including her telephone set and a battery, one of the connecting-plugs being generally arranged to be used for this purpose. Obviously when the testing-plug is thus applied to an insulated test-contact of a line which is not in use no effect is produced in the telephone, since no circuit is closed; but when the line tested is in use the battery described finds circuit through the telephone of the operator making the test to the test-plug, and thence through the test-contacts to the line-circuit, and thence to earth, and the current generated causes a click in the telephone. Thus the operator finds it necessary to operate her switch-keys to connect her telephone to and disconnect it from each cord-circuit with which she may desire connection and may require to connect



the telephone several times to one line, and a considerable portion of her time is consumed in manipulating these keys.

My invention aims to dispense with the switch-keys.

I connect the operator's telephone and test-battery directly to the conductors of the plug-circuits of all the connecting-plugs belonging to the particular operator. To prevent the telephonic current escaping from one pair of plug-circuits to another, I include a retardation-coil in each branch from a plug-circuit to the common telephone. Current from any plug-circuit to the operator's telephone meets only the resistance of a single retardation-coil and a sufficient amount of the telephonic current escapes by that path or is shunted from the telephone-line through the operator's telephone to enable the listening operator to determine whether conversation is still being carried on over the line. At the same time the resistance between any two plug-circuits is so great that the amount of current escaping from one telephone-line to another is inappreciable. The continuous testing-current through the operator's telephone from the test-battery traverses the retardation-coil readily, and hence the operator may test a line at any time by means of any connecting-plug. It is thus necessary only for the operator to insert one plug of a pair into a spring-jack of a line from which a call has been received and to make the test of the line called for with the remaining plug of the pair, and having found the line not busy to insert the testing-plug fully into the spring-jack. The manipulation of the keys is avoided, permitting the connection between the different lines to be more quickly performed and enabling an operator to receive and attend to a greater number of calls than heretofore.

Hitherto it has been necessary to include a second signal-receiving device, known as a "clearing-out annunciator," in the circuit between the different plugs of a pair, in order that the connected subscribers, when they have finished their conversation, may signal for disconnection in case the operator's telephone be disconnected from the circuit.

When my invention is employed, the clearing-out annunciator is unnecessary. It is well known in the art that an operator in a telephone-exchange system soon becomes familiar with the voices of those to whose calls she attends, and hence, when provided with apparatus organized as in my invention, she is readily enabled to determine whether two subscribers whom she has connected have finished their conversation or not.

In practice I find it desirable to employ in connection with my annunciator contact-pieces upon which the different plugs rest while not in use and with which they make electrical contact, the contact-pieces being connected directly with the operator's telephone, and I include the operator's transmitting instrument in this branch between the

said contact-points and the telephone-receiver. Hence when only one plug of a pair is in use, as in answering a call from a line, the plug is connected, through the medium of the other plug and the contact-piece upon which it rests, directly through the transmitter with the operator's telephone, so that in the case mentioned the operator receives from and transmits to the substation the full telephonic current of the instruments undiminished by the impedance of the retardation-coil. These contact-pieces, in combination with the plugs resting upon them, are well known in the art and do not in themselves constitute a feature of my invention herein; but the inclusion of the transmitter in the branch therefrom to the telephone-receiver constitutes one feature of my invention.

Thus in a switching system organized in accordance with my invention the apparatus itself of the switchboard is greatly simplified by the omission of much of the mechanism, and the work of establishing connections between lines is performed with greater facility and expedition.

My invention is illustrated in the accompanying drawings, Sheets 1 and 2.

In Figure 1, Sheet 1, of the drawings I have shown two pairs of terminal plugs connected by conductors including the usual calling-keys and connected through retardation-coils with the telephone and test-battery in accordance with my invention. In Fig. 2, Sheet 2, I have shown diagrammatically four grounded telephone-lines extending from substations to a telephone-exchange and connected with spring-jacks and with annunciators thereat, one of the switchboards being equipped with two pairs of connecting-plugs arranged similarly to those in Fig. 1. Two of the telephone-lines are represented as connected together and a third as having initiated a call, the operator's apparatus being in position for receiving the order.

Referring to Fig. 1,  $a$   $a'$  and  $a^2$   $a^3$  are metallic connecting-plugs of well-known construction. The different plugs are respectively connected with the springs  $b$  of calling-keys  $c$ ,  $c'$ ,  $c^2$ , and  $c^3$ , each having a normal resting contact  $b'$  and an alternate contact  $b^2$ . The resting contacts of each pair of keys are connected together by conductors, and the alternate contacts  $b^2$  are connected with one terminal of a calling-generator  $d$ , whose other terminal is grounded. Thus by depressing any key the corresponding plug of one pair is disconnected from the other plug of the pair and is looped into circuit with the calling-generator. The plugs normally rest in sockets in the switchboard-frame upon plates  $e$  and  $e'$ , respectively, for the different pairs of plugs of conducting material. Each of the conductors joining the resting contacts of the keys—that is, uniting the two members of a pair of plugs—is connected through a different retardation-coil with a branch through the operator's telephone-receiver  $f$  and a test-



battery  $g$  to earth. Thus the conductor joining plugs  $a a'$  is connected therewith through retardation-coil  $i$ . The conductor joining plugs  $a^2 a^3$  is similarly connected through coil  $i'$ . The plates  $e$  and  $e'$  are connected by a branch wire with the telephone-receiver  $f$ . The secondary helix of the induction-coil of the operator's transmitter  $f'$  is included in the branch between pieces  $e e'$  and receiver  $f$ .

Referring now to Fig. 2, I will describe the apparatus shown therein and will trace the different operations involved in establishing connection between two lines. The substations 1, 2, 3, and 4 are supposed to be equipped with the ordinary substation apparatus, which is so well known as to require no description. Each substation is shown connected in a grounded circuit with its particular spring-jacks or connection-terminals and an annunciator or signal-receiving device at the central office. The annunciators of two of the lines are supposed to be located upon one switchboard and the remaining two upon another switchboard, so as to be under the care of a different attendant operator. Thus the substation 1 is connected by a line-wire  $k$  to the line-spring of a spring-jack  $l$  upon the first switchboard, which may be designated  $m$ . From the normal resting contact of the line-spring of jack  $l$  connection is made to line-spring of a jack  $l'$  upon the other switchboard,  $m'$ , and from the resting contact of that jack the circuit extends back to the switchboard  $m$  and through an annunciator  $n$  thereat to earth. The substation is thus in a grounded circuit including the apparatus of the substation, the spring-jacks  $l l'$  upon the two different switchboards, and the annunciator  $n$  at one of the switchboards. The spring-jacks  $l$  and  $l'$  are provided with testing-contacts  $o$ , as described, in front of the jacks, the testing-contacts being connected together, but normally insulated from the line.

The apparatus connected with station 2 is precisely similar to that of station 1 and is connected in a similar circuit. The annunciator  $n'$  is, however, shown as located upon the switchboard  $m'$ , so as to be under the care of the operator thereat. The circuits and apparatus from stations 3 and 4 are also the same as those described, the annunciators being located upon the boards  $m$  and  $m'$ , respectively.

The operator's connecting appliances are not shown at the switchboard  $m$ , but are shown complete at the board  $m'$ . The plugs  $a a'$  are shown in position of connecting together the lines from stations 3 and 4. The plug  $a^2$  is inserted in the spring-jack of line to station 2 to answer the call from that line, while the other plug,  $a^3$ , of that pair is in its idle position.

The subscriber, for example, at station 2, desiring a connection with some other line, actuates his signaling-generator at the substation in the usual manner, thereby energizing the electromagnet of annunciator  $n'$  and

causing the indicator or shutter of the annunciator to be thrown down. The operator at that board thereupon inserts one plug,  $a^2$ , into the spring-jack  $l^2$  of the corresponding line. The line-spring of jack  $l^2$  is thus raised from its resting contact, disconnecting the annunciator  $n'$ . At the same time the test-piece or test-ring  $o$  is crossed with the line-spring and is thus grounded through the grounded line-circuit, as described. The circuit is now from substation 2 over the line  $k'$  to the jack  $l^2$ , thence to the plug  $a^2$ , thence through the conductor connecting the two plugs to the plug  $a^3$ , thence to the plate  $e'$ , upon which the plug rests, and thereby to the operator's telephone set  $f f'$ . The operator is thus enabled to communicate directly with the subscriber at station 2 and to receive the order for the desired connection. Suppose the line with which connection is required to be that to station 1, the operator then applies the tip of plug  $a^3$  to the test-piece  $o$  of the jack  $l'$  at her board, whereby circuit is completed from the test-battery  $g$  through the telephone  $f$  and the retardation-coil  $i'$  to the test-plug  $a^3$  and to the connected series of test-contacts  $o$  of line to station 1. When these are insulated from the line-circuit, as shown in the drawings, no effect is produced in the telephone  $f$  by such application of the plug  $a^3$  to the test-ring, but if a connecting-plug were inserted in any spring-jack of the line, as plug  $a^2$  in jack  $l^2$ , the test-rings would be grounded, as described, and the current thus allowed to flow through the telephone  $f$  would cause a click therein, indicating the "busy" condition of the line to the operator. Having found the line to be not in use, the operator inserts the plug  $a^3$  fully into the spring-jack  $l'$ . She then depresses key  $c^3$ , thereby disconnecting the plug  $a^3$  from the remainder of the operator's outfit and connecting it with one pole of the generator  $d$  to send a calling-current to the substation 1.

The operator, listening at telephone  $f$ , is enabled to hear when the subscriber at station 1 responds and begins conversation with subscriber at station 2 by means of the slight portion of the telephonic current which is shunted through the retardation-coil  $i'$  and the telephone  $f$ . At the same time any perceptible leakage of the telephonic current from this pair of connected lines to the lines of stations 3 and 4 is prevented by the great impedance encountered in traversing the two retardation-coils  $i$  and  $i'$  and by the shunting effect of the low-resistance branch through the telephone to earth. Having heard the subscribers at stations 1 and 2 enter into conversation, the operator readily recognizes their voices and is enabled to know when they have finished their communication and hung up their telephones. If either should send a signal for disconnection by rotating his generator, as is customary with the present apparatus, this also would be a sufficient signal to the operator for the removal of the connection between the lines.



It will be noted that the subscriber may at any time address the operator directly, as, for instance, if he should have received the wrong connection and desired to call her attention to the error; but when the operator addresses the subscriber, as in receiving the order, the current from her transmitter finds circuit only to the particular subscriber addressed.

I am aware that telephone-exchange systems have been devised and used heretofore in which a large number of subscribers' lines are connected with a telephone at which is stationed a constantly-listening operator to receive the calls and establish connections between the lines, but I believe myself to be the first to make use of a very small portion of the talking-current shunted from lines in use for the purpose of keeping the operator informed of the condition of the lines, and also to connect the conductors of the testing-plugs together through retardation-coils to a common telephone and test-battery in order that the operator may be enabled to test any line readily. I have described the permanent telephone connections as being made with the conductors of the plug-circuits; but it will be obvious that such connection might be made with any of several different points of line-circuits in use without departing from the spirit of my invention.

I therefore claim as new and desire to secure by Letters Patent—

1. The combination with several pairs of connecting-plugs, of conductors joining the different members of each pair, branches connecting each of said conductors with one terminal of an operator's telephone, and retardation-coils included in said branches, substantially as described.

2. The combination with several pairs of connecting-plugs, of conductors joining the different members of each pair, a branch from each of said conductors to an operator's telephone set and test-battery, and a retardation-coil included in each of said branches, substantially as described.

3. In combination, pairs of connecting-plugs, the different members of each pair being connected by conductors, a socket for each of said plugs wherein the plug normally rests and with which it makes electrical contact, conductors connecting each of said pairs of plugs through a retardation-coil to the operator's telephone, and other conductors connecting the said plug-sockets directly with the telephone, whereby an operator receives the full telephonic current when receiving an order from a substation, but only a very small shunted portion of the telephonic current of two subscribers in connection, substantially as described.

4. The combination with an operator's receiving-telephone and transmitting-telephone, of circuit connections uniting the receiving-telephone with all of several telephone-lines in use, a separate circuit containing the transmitting-telephone, and switching mechanism adapted to automatically connect the said separate circuit with the line of a calling-subscriber in the act of making connection with the said line, substantially as described.

5. The combination with two telephone-lines each extending from a substation to a common central station and connected with several spring-jacks thereat, of normally-insulated test-pieces upon the spring-jacks, and means for grounding the same when connection is made to the line, pairs of connecting-plugs, the different members of each pair being connected together by conductors, a signal-receiving device connected through a retardation-coil with each of said pairs of plugs, and a test-battery in circuit with said signal-receiving device, substantially as described.

6. The combination with several connecting-plugs, of conducting-cords connecting the said plugs in pairs, the telephone-receiver connected through high resistance with each of said conducting-cords, sockets for the plugs with which they make electrical contact, and a telephone-transmitter connected in a branch between the said sockets and the telephone-receiver, substantially as described.

7. The combination with several pairs of united telephone-lines, of an operator's telephone-receiver normally connected through resistances with all of the lines, a transmitter normally disconnected from the telephone-lines and in a circuit with the receiver, and switching apparatus for closing the circuit containing the telephone transmitter and receiver in direct connection with a particular line, substantially as described.

8. The combination with several telephone-lines, of a telephone-receiver and a telephone-transmitter permanently connected in a conductor, a common branch from the telephone-lines to said conductor at a point intermediate between the receiver and the transmitter, and means for connecting the free terminal of the transmitter with any telephone-line, whereby the telephone-receiver is permanently in circuit with all of the lines, while the transmitter and receiver may be brought into circuit with any particular line.

In witness whereof I hereunto subscribe my name this 16th day of November, A. D. 1892.

CHARLES E. SCRIBNER.

Witnesses:

ELLA EDLER,  
LUCILE RUSSELL.