(No Model.) 2 Sheets—Sheet 1.

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,392. Patented Oct. 26, 1897.

Fig. 2

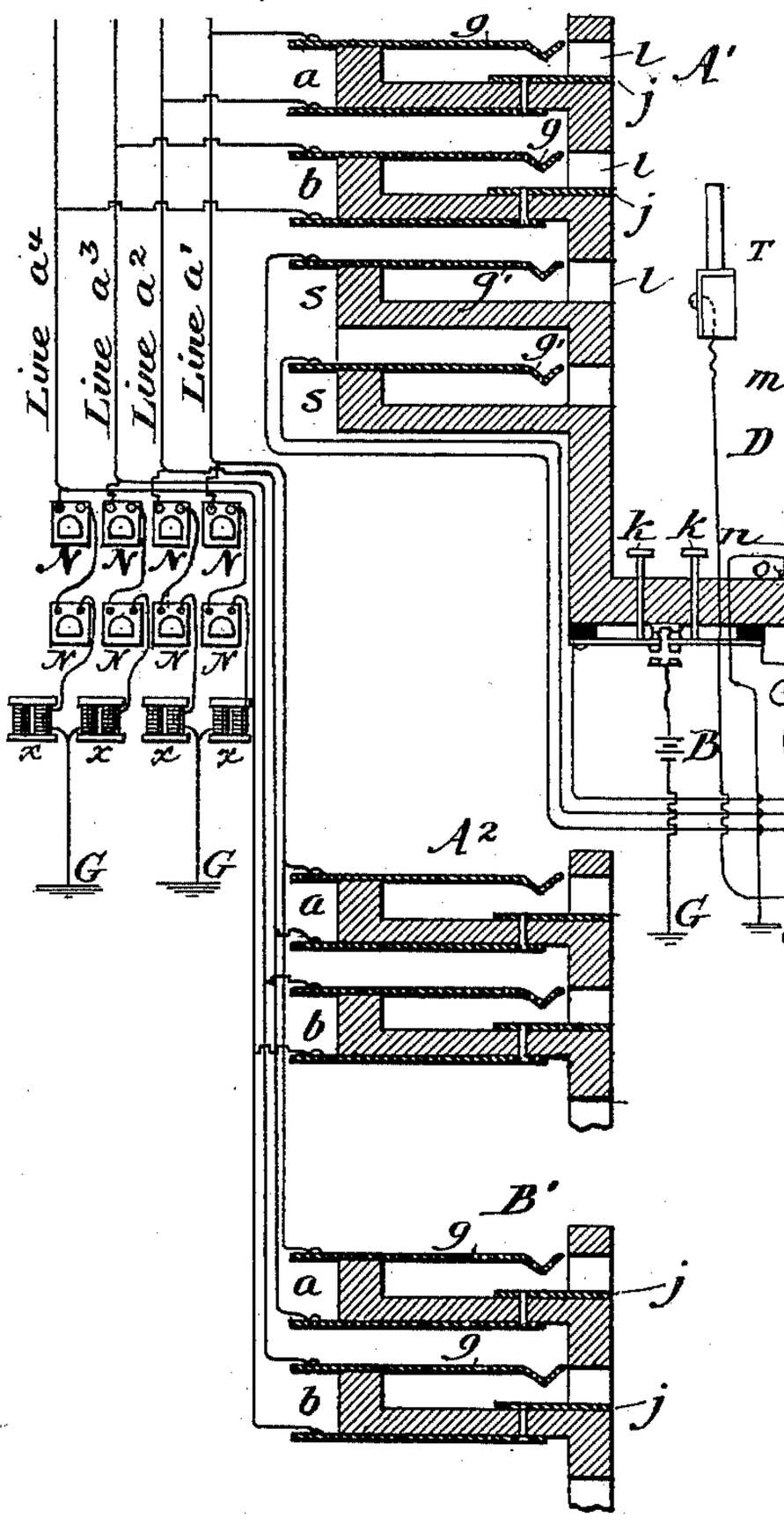


Fig. 1.

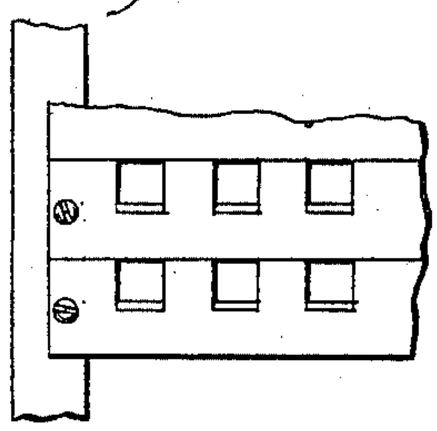
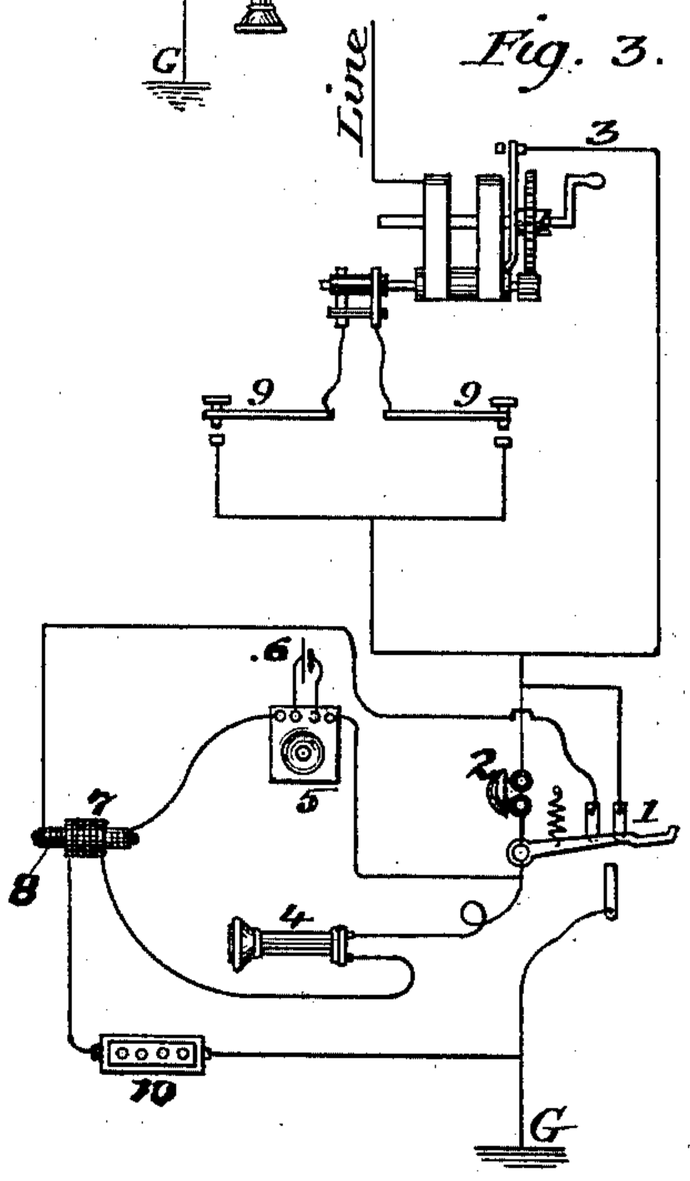


Fig. 3.



Witnesses:
Frank L. Blanchard
Morris J. Kelly.

Inventor:
Milo G. Kellogg
by his Attorneys
Baldwin, Davidson & Wright

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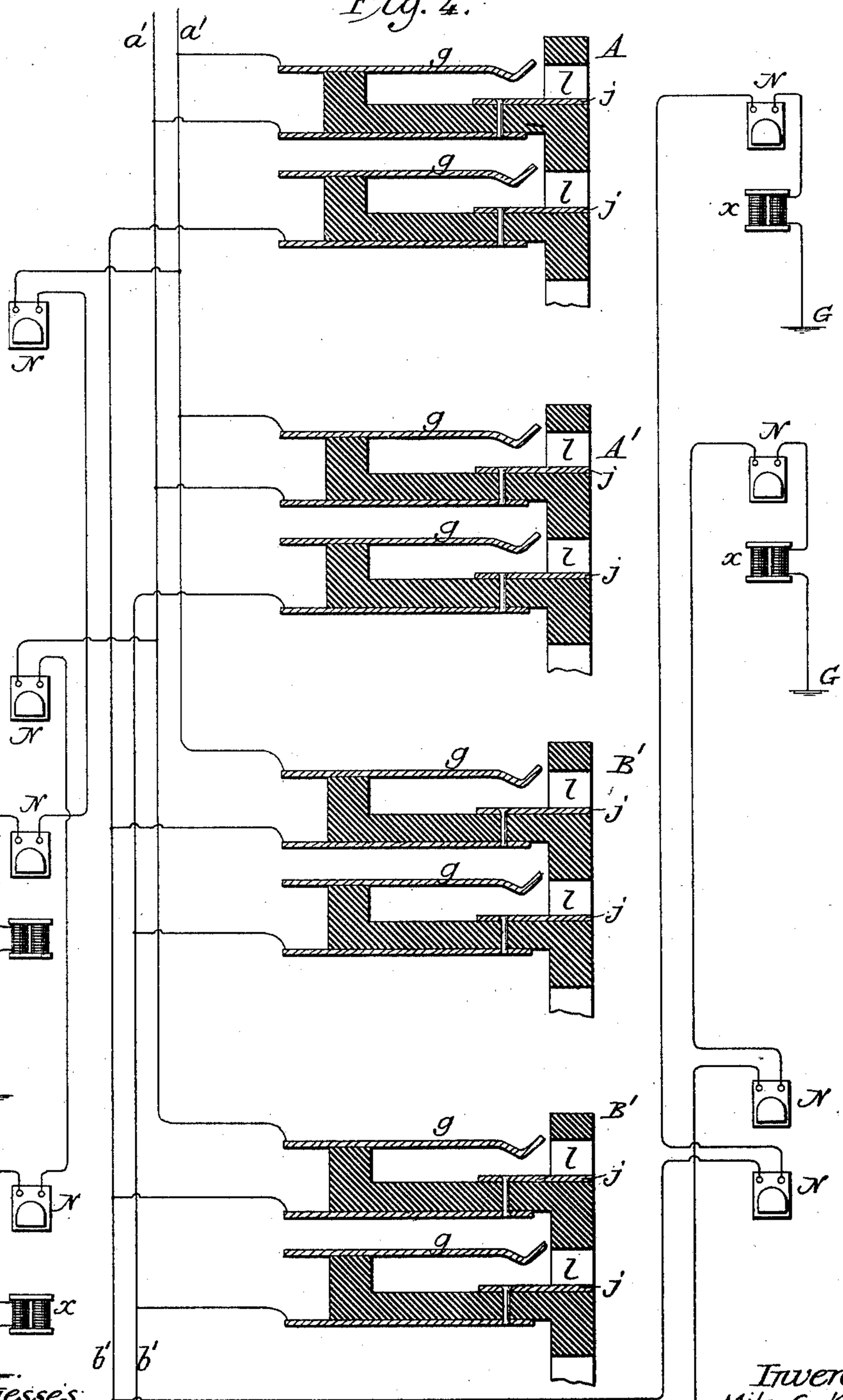
Fig. 4.



Witnesses;
Sidney P. Hollingsworth
B. Washington Miller.

Inventor;
Milo G. Kellogg.
by his attorneys.
Baldwin, Davidson & Wright.

UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF SAME PLACE.

MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,392, dated October 26, 1897.

Application filed May 14, 1891. Serial No. 392,718. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Multiple Switchboards for Telephone-Exchanges, 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 a telephone-exchange system in which the lines and the multiple switchboards of the exchange are divided into several (two or more) classes and each line of one class has a switch on each board of its class and on a board of each of the other classes, which system is frequently designated as the "divided exchange" system.

The first divided exchange system invented was that of my Patent No. 424,310, dated March 25, 1890.

My invention also relates to a telephone-exchange system in which the lines are divided into pairs, each pair of lines having a switch on each board to which it should be connected, and each switch having two contact-pieces suitably placed and insulated, one of the lines of a pair of lines being connected with one of said switch contact-pieces and the other line being connected with the other switch contact-piece.

My invention consists in a system of exchange apparatus in which such divided exchange system and such divided switch system are practically united.

The following drawings illustrate apparatus which embody my invention.

Figure 1 is a front view of a section of the switchboards. Fig. 2 shows sections of three boards, two boards in one class or division of boards and a third board in a second class or division of boards. The boards of the first class are marked A′ A^2 and that of the second class is marked B′. It also shows two pairs of lines of one class or division of lines with their connections to their switches, their annunciators and other central-office apparatus, and a pair of switch-plugs located at one of the boards and connected to the operator's special apparatus and their own special apparatus, which will hereinafter be described. Fig. 3 shows in diagram a subscriber's-station apparatus which may be used in an exchange system where the lines and boards are divided into two classes or divisions. Fig. 4 shows two divisions of boards with sectional diagram views of sections of two boards of each division and two lines of each division and two annunciators and one retardation-coil for each line, the lines being connected to their respective switch-contacts and annunciators and retardation-coils, substantially as shown and as will be described.

In Fig. 2, switches of the lines are marked *a a a* and *b b b*, the three former being located on the three boards shown and the three latter being also located on the boards shown, respectively. There is one switch for each pair of lines on each board of their class or division of boards and on one board of each of the other classes or divisions of boards.

l l are the switch-holes through the fronts of rubber strips of the shape substantially as shown and on which the metal parts of the switches are mounted. These holes are preferably square or rectilinear. To one side of the center of the holes are the contact-springs *g g*. On the opposite sides of the center of the holes and along the surface of the holes are placed the contact-pieces *j j*. There is one spring *g* and one contact-piece *j* for each switch.

Of the four lines shown in Fig. 2, line *a′* is connected with the contact-springs *g g g* of the switches *a a a* shown on the three boards, and line a^2 is connected with the contact-pieces *j j j* of the same switches. Lines a^3 and a^4 are connected in like manner with the springs *g g g* and contact-pieces *j j j*, respectively, of switches *b b b*.

N N, &c., are polarized annunciators, and *x x*, &c., are retardation-coils, two annunciators and one retardation-coil for each line. Each line is connected to ground through its two annunciators and retardation-coil, and the annunciators are connected in the circuit in opposite polarity and located at the two classes or divisions of boards and at boards where the line has switches.

D D′ are a pair of switch-plugs adapted to

be inserted into any switch at their board and to form connections when inserted, as will hereinafter be described.

n n are the rubber insulations of the plugs, and *m m'* are the two contact-pieces of a plug.

When a plug is placed into a switch, it may be inserted in such a direction that its piece *m* forms connection with spring *g* and its piece *m'* forms connection with contact-piece *j* of the switch, or in the reverse direction, so that *m* forms connection with *j* and *m'* forms connection with *g*.

For each switch-plug there is a switching device into which any other plug located at its board may be placed and which has a contact-piece which connects with the contact-piece of the plug thus inserted. The contact-piece of this switching device is connected through a flexible switch-conductor with contact-piece *m'* of its plug. These switching devices are marked *s s*.

The contact-pieces *m m* of a pair of plugs are connected together by a flexible-cord circuit, and in this cord-circuit are a test-battery B', a clearing-out annunciator *v*, and the normally closed contacts of the two calling-keys K K.

The contact-piece *m* of the plug D has an extension-piece which passes to the bottom of the plug and which normally, or when the plug is not in use for switching, forms connection with plate *o* and with the ground through such connection. The contact-piece *m* of plug D' is not thus constructed with the extension-piece and normally connected with the ground. The reason for this difference in the construction of the two plugs will appear later in this specification.

Y is a looping-in switch with contacts *p p* and *q q* and connections by which the operator's telephone may be looped into said cord-circuit.

There is one test-battery B', one clearing-out annunciator *v*, two calling-keys K K, and one looping-in switch Y for each pair of plugs.

B is the operator's calling-generator, and *t* is her telephone.

I is an induction-coil the secondary of which is in circuit with the operator's telephone.

T is a test-plug which terminates a flexible-cord circuit and the contact-piece *i* of which is adapted to be brought for testing with either of the pieces *g* or *j* of any switch at its board or with spring *g'* of any plug switching device at its board. The other end of said flexible-cord circuit is connected to ground through the primary of the induction-coil.

The two keys K K of a pair of plugs are connected into their cord-circuit, one on each side of the test-battery, and their levers are connected with the contacts *m m*, respectively, of the two plugs. The lower contacts of the keys are connected with one side of the calling-generator, and the other side of the generator is grounded.

Each operator has as many pairs of plugs as she may reasonably require for her work, and they are connected to their special apparatus and to the operator's apparatus substantially as shown and as heretofore described.

In Fig. 4, A' A' are the two boards of one division of boards, and B' B' the two boards of the other division of boards. *a' a'* are the two lines of one division of lines, and *b' b'* the two lines of the other division of lines. Each line has a switch contact-piece *g* or *j* on each board of its division of boards and on one board of the other division of boards and is connected to each of its switch contact-pieces. It is also grounded through its two polarized annunciators N N, connected in opposite polarity, and its retardation-coil *x*. The two annunciators of a line are located at boards of the two division of boards and where its calls are to be answered.

In the subscriber's-station apparatus shown in Fig. 3, 1 is the telephone-switch. 2 is the signal-receiving bell. 3 is the calling-generator. 4 is the subscriber's telephone. 5 is the transmitter; 6, the transmitter-battery; 7, the secondary, and 8 the primary, of the induction-coil, and 9 9 two calling-keys. 10 is a resistance-coil.

The generator is constructed with the usual automatic device, whereby it is shunted or switched from the line-circuit while it is not being operated. The insulated contact-piece on the shaft of the armature, to which is connected one end of the armature-coil and which conducts the generated current to the line, is a half-circle, the remaining part of the circle being an insulation, as shown. The levers of the two keys are connected to the two contact-springs, respectively, of the generator, against which springs the insulated piece alternately bears as the armature is revolved.

When the telephone is on the lever, the circuit for received calling-currents is by way of the shunt around the generator, through the call-bell to the telephone-lever, and thence to ground. When the generator is operated to send a call to the central office, the circuit is from ground at the subscriber's station to the telephone-lever, through the call-bell and whichever of the keys 9 that is depressed, and generator-armature to line. When the telephone is off its lever, the circuit is from line through the shunt around the generator, around the bell to the lever, and thence through the telephone, secondary of induction-coil, and resistance to ground.

It is apparent from the above description of the circuits and from the drawings that when the telephone is on the switch the signal-bell is in the circuit of the line and the telephone, the secondary of the induction-coil, and resistance-coil are shunted or short-circuited, so that their resistance is practically

switched from the circuit, and that when the telephone is off the switch the telephone, secondary of induction-coil, and resistance-coil are in the circuit of the line and the signal-bell is short-circuited, so that its resistance is practically switched from the circuit.

In well-organized apparatus the resistance of the telephone and secondary of the induction-coil combined aggregate about four hundred ohms, while that of the signal-bell is about one hundred ohms. The resistance while the subscriber's telephone is switched for use is from this difference in resistance much greater than is the resistance when it is not thus switched. If this difference is not sufficient to cause an easy adjustment of the circuits and apparatus for the operation of the clearing-out signal, hereinafter to be indicated, such additional resistance as may be required may be placed in the resistance-coil 10.

The automatic device of the calling-generator normally shunts the normally open contact-points of the keys as well as the generator.

It is well known that when calling-generators are operated a current of one polarity is generated during one half the revolution of the armature and the current of the other polarity is generated during the other half of the revolution of the armature. The two contact-springs are so placed with reference to the armature that one of them takes the current of one polarity and the other one takes the current of the other polarity.

It is also apparent from the above description of the circuits and apparatus that when the generator is being operated and one of the keys depressed a current of one polarity will go to the line, and when the other key is depressed a current of the other polarity will go to the line. The subscriber can therefore at will operate either of his polarized annunciators at the central office and call to a board of each class of boards and where his line has a switch.

The operation of the system is as follows: When the subscriber finds out to what class of lines the line he wishes belongs, he presses on his key 9 corresponding to that class and operates his generator. The operator at the board where the call is indicated places plug D′ of a pair of her plugs into the switch of the line wanted (if there is not already a plug in the switch) and in such a direction in the switch that the contact-piece *m* of the plug forms connection with that contact-piece of the switch which is connected to the line. She then moves the lever of the looping-in switch of the pair of plugs into such a position that her telephone is in circuit with them. A complete circuit then exists from the ground to plate *o* and contact *m* of the plug D, thence through her telephone to the line, and thence to ground at the subscriber's station. The operator finds out by conversation what line is wanted. She then tests the line wanted, and if it is "free" or unswitched she connects the contact *m* of the other plug of the pair with the line wanted. Then by pressing on one or the other of the calling-keys she may send a calling-current through either line. When the line wanted does not have its switch with a plug inserted therein for another connection, (with another line of said switch,) she tests the line by placing the contact-piece *i* of her test-plug into connection with that contact of the switch which is connected with the line wanted. When the line tests "free," she places the other plug of the pair into the switch in such a direction that the piece *m* of the plug forms connection with that contact of the switch which is connected with the line.

As heretofore described, when a plug is inserted into a switch in such a direction that its piece *m* forms connection with one of the contacts of the switch, the piece *m′* is then in connection with the other contact of the switch. Since piece *m′* of the plug is in connection with piece *g′* of the switching device of the plug, it follows that the line with which piece *m′* then connects terminates temporarily in piece *g′* of the switching device. When, therefore, an operator desires to test or switch a line in whose switch is already a switch-plug, she merely inserts her test or switch plug, as the case may be, into the switching device of the plug inserted into the switch, and she thereby makes connection with such line.

When an operator on receiving a call finds that a switch-plug is already in the switch of the calling-line, she connects with the line through the switching device of the plug.

The operation of the test system is as follows: When a line is not switched, it is not in circuit with a battery. When it is switched, it has in circuit with it the battery of the pair of cords used for switching. When the test is applied and the line is switched, there is a circuit from the ground through the primary of the induction-coil to the contact of the line where the test is made, thence to the contact of the line where the line is switched, thence through the test-battery to the other line, and thence to both ground connections of the other line. As the operator's telephone and the secondary of the induction-coil are then on closed circuit, the telephone will indicate the closing of the battery-circuit and the operator will thereby know that the line is in use. When the test is made and the line is not switched, no circuit is established which contains a battery, and as her telephone will not then indicate she knows that the line is free to be connected to.

It will be seen that when two lines are connected together for conversation the circuit is connected to ground at the central office through the annunciators and retardation-coil of each line. These instruments are of

large resistance and high retardation, so that such ground connection will not seriously affect the talking-circuit. The annunciators themselves have so much retardation that it may in certain places be considered unnecessary to use special retardation-coils.

When a signal-current is sent from the central office to either line, it goes to ground through the circuit of the line and the subscriber's-station bell and also to ground at the central office through the two line-annunciators and retardation-coil. As the last-mentioned circuit to ground has much the larger resistance, by far the greater portion of the current will go over the other circuit. The apparatus and resistances should be so constructed that when a call is made from the central office to a line there will not enough current go through the line-annunciators to operate them.

It will be seen that the test-batteries are normally, or when their plugs are not in use for switching, on open circuit and are therefore not under consumption. This result is obtained by the construction of the plugs in connection with the ground contact-plate, as heretofore described.

The clearing-out annunciators should be non-polarized annunciators and so constructed and adjusted that when one of them and its battery are closed to the circuit of any two lines and the subscribers' telephones are switched for use, thereby, as heretofore indicated, including a large resistance in the circuit, the battery will not cause the annunciator to indicate a call; but when the telephones are restored to their switches, thereby greatly reducing the resistance of the circuit, the battery-current will be so great as to operate the annunciator. The mere act of restoring the telephones to their normal positions thereby causes a clearing-out signal to be indicated at the central office. The batteries B′ B′ may be of such size as to conveniently produce this arrangement and operation.

It will be seen that on account of the system of operating the lines in pairs, with one switch for each pair, the number of switches is reduced by one-half for a certain number of lines as compared with the usual multiple-switchboard organization, and that on account of the divided exchange system the number of switches are again reduced by a large per cent. For instance, for an exchange of twelve thousand lines, divided into two divisions, about three thousand two hundred switches would be required on each board instead of twelve thousand required in the usual system.

I have described a two-division system of operation. My invention is equally applicable to greater number of divisions which may be employed.

The primary of the operator's induction-coil should be of such high resistance that it will not cause a clearing-out annunciator to indicate when closed for testing to the circuit of any switched line.

I claim as my invention and desire to secure by Letters Patent—

1. In a telephone-exchange system, telephone-lines divided into divisions, the lines of each division divided into pairs, multiple switchboards for said lines divided into divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of each of the other divisions, and each switch having a switch connection for each line of its pair, in combination with switching apparatus whereby the operator at any board may electrically connect together any two circuits or lines which have such switch connection at her board, substantially as set forth.

2. In a telephone-exchange system, telephone-lines divided into two divisions, the lines of each division divided into pairs, multiple switchboards for said lines divided into two divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of the other division and each switch having a switch connection for each line of its pair, in combination with switching apparatus whereby the operator at any board may electrically connect together any two circuits or lines which have their switch connection at her board, substantially as set forth.

3. In a telephone-exchange system, telephone-lines divided into divisions, the lines of each division divided into pairs, multiple switchboards for said lines divided into divisions, one division of boards for each division of lines and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of each of the other divisions and each switch having a switch connection for each line of its pair, in combination with calling apparatus whereby one subscriber may send a call to two boards, one in each division and at a board where his line has a switch connection and switching apparatus whereby the operator at any board may electrically connect together any two circuits or lines which have switching connection at her board, substantially as set forth.

4. In a telephone-exchange system, telephone-lines divided into two divisions, the lines of each division divided into pairs, multiple switchboard for said lines divided into two divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division, and on one board only of the other division and each switch having a switch connection for each line of its pair, in combination with calling apparatus whereby any subscriber may send a call to two boards, one in each division and at a board where his line has a switch connection and switch apparatus whereby the operator may electrically connect together

any two circuits or lines which have switching connection at her board, substantially as set forth.

5. In a telephone-exchange system, telephone-lines divided into two divisions, the lines of each division divided into pairs, multiple switchboards for said lines divided into two divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of the other division and each switch having a switch connection for each line of its pair, in combination with two annunciators for each line located in the two divisions and at boards in which the line has switch connection, subscriber's calling apparatus for each line whereby he may at will make either annunciator of his line indicate a call, and switch apparatus whereby the operator at any board may electrically connect together any two circuits or lines which have switch connection at her board, substantially as set forth.

6. In a telephone-exchange system, telephone-lines divided into two divisions, the lines of each division divided into pairs, multiple switchboards for said lines, divided into two divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of the other division and each switch having a switch connection for each line of its pair, in combination with two polarized annunciators for each line connected in opposite polarity in the circuit of the line and located in the two divisions of boards and at boards where the line has switch connection, a signaling-generator at each subscriber's station, switch apparatus whereby the subscriber may at will send a current of either polarity over his line-circuit and connecting apparatus whereby the operator at any board may electrically connect together any two lines which have switch connection at her board, substantially as set forth.

7. In a telephone-exchange system, telephone-lines divided into divisions, the lines of each division divided into pairs, multiple switchboards for said lines divided into divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of each of the other divisions and each switch having a switch connection for each line of its pair, in combination with two annunciators for each line located in two divisions of boards and at boards where the line has switch connection, subscriber's calling apparatus for each line whereby he may at will cause either annunciator to indicate a call and switching apparatus whereby the operator at any board may electrically connect together any two lines which have switch connection at her board, substantially as set forth.

8. In a telephone-exchange system, telephone-lines divided into divisions, the lines of each division divided into pairs, multiple switchboards for said lines divided into divisions, one division of boards for each division of lines, and switches for said lines, one switch for each pair of lines on each of the several boards of their division and on one board only of each of the other divisions and each switch having a switch connection for each line of its pair, in combination with two polarized annunciators for each line connected in opposite polarity in the circuit of the line and located at two divisions of boards where the line has switch connection, a signaling-generator at each subscriber's station, switch apparatus whereby the subscriber may at will send a current of either polarity over his line-circuit, and connecting apparatus whereby the operator at any board may electrically connect together any two lines which have their switch connection at her board, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
FRANK S. OBER,
EDWARD C. DAVIDSON.