

M. G. KELLOGG.

MULTIPLE SWITCHBOARD FOR TELEPHONE EXCHANGES.

APPLICATION FILED FEB. 28, 1891.

NO MODEL.

Fig. 1.

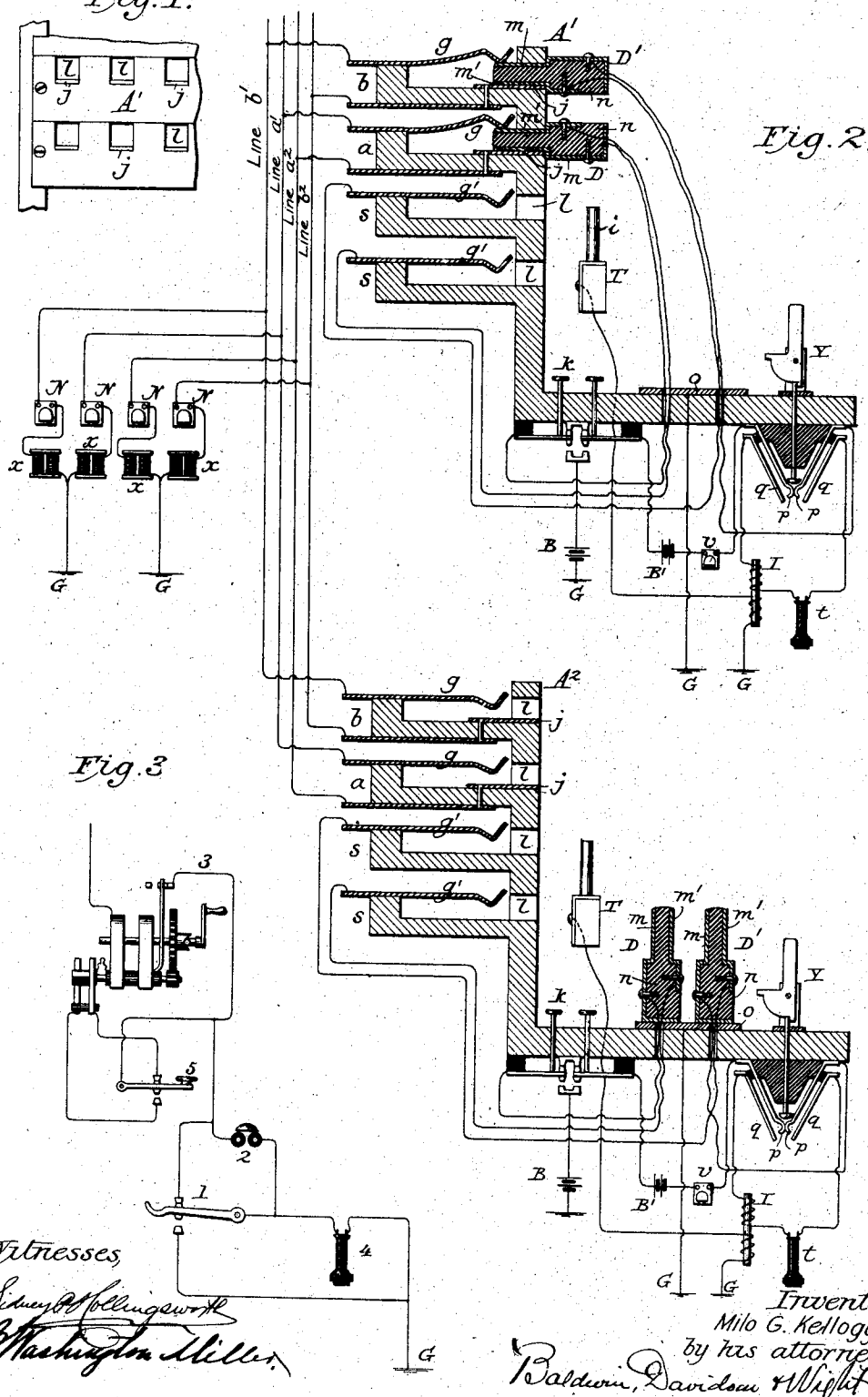
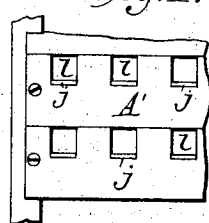
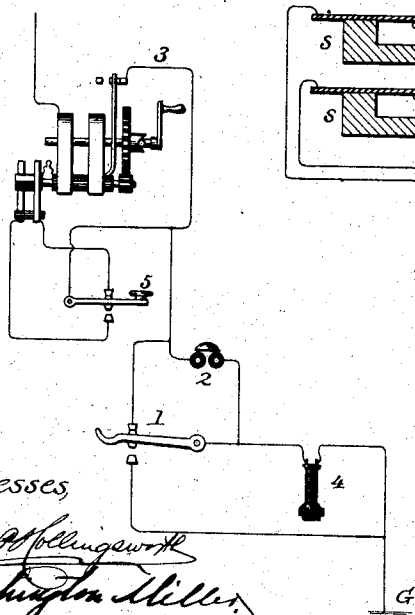


Fig. 3.



Witnesses
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UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

MULTIPLE SWITCHBOARD FOR TELEPHONE-EXCHANGES.

SPECIFICATION forming part of Letters Patent No. 773,506, dated October 25, 1904.

Application filed February 28, 1891. Serial No. 383,260. (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 are grounded at their outer ends and are grounded at the central office.

Briefly stated, my invention consists in connecting the telephone-lines in pairs with the different switches on the boards, there being on each board one switch for each pair of lines 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 with the other switch contact-piece, and in switch-plugs, apparatus, and connections by which with such lines and switch connections the calls of the subscribers may be received and promptly attended to and the usual operations of the exchange gone through with.

Figure 1 is a front view of a section of the switchboards. Fig. 2 shows sections of two boards A' and A'' , with four lines connecting to them, four annunciators for the lines, with their connection to their respective lines and to the ground, and a pair of switch-plugs located at each of the boards and connected to the operator's apparatus and to their own special apparatus, which will hereinafter be described. Fig. 3 shows in diagram a subscriber's-station apparatus. The switches of the lines are marked $a a$ and $b b$, the two former being located on the two boards shown and the two latter being also located on the two boards shown, respectively.

$l l$ 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.

Four lines are shown in the drawings. Line a' is connected with contact-springs $g g$ of switches $a a$ and line a'' with contact-pieces $j j$ of the same switches. In like manner lines b' and b'' are connected with springs $g g$ and pieces $j j$, respectively, of switches $b b$.

$N N$ are annunciators, and $x x$ are retardation-coils, one annunciator and one retardation-coil for each line. The line is connected to the ground through its annunciator and retardation-coil, and the annunciator is located at the board where the calls of the line are to be answered.

$D D'$ 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 inserted 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 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 m 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 . 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 $K K$ and the looping-in switch Y . 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 similarly constructed and normally connected with the ground.

Y is a looping-in switch with contacts *p p 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 cords.

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

I is an induction-coil, the secondary coil 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 into connection 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, and their two levers are connected with the two contacts *m m*, respectively, of the plugs. The lower contacts of the key 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 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, and 5 is a calling-key. The generator is constructed with the usual automatic device whereby it is shunted or switched from the line-circuit while not operated. The insulated contact-piece on the shaft of the armature, to which is connected one end of the armature-wire and which conducts the generated current to line through the contact-springs provided for it, is a half-circle, the remaining part of the circle being an insulation, as shown. The key 5 is provided with two pairs of contacts, as shown, one pair being normally closed and the other pair normally open, and when the key-lever is depressed the normally closed pair of contacts is opened and the normally open pair is closed. The connections of the key to the contact-springs of the generator and to the line-circuit is as follows and as shown: The spring-lever which forms one of the contacts of each pair of contacts is connected with one side of the main-line circuit. The two other contacts of the pairs of contacts are connected to the two contact-springs,

respectively, of the generator. As before stated, one end of the armature-coil is connected with the half-circle contact-piece, and against this piece the springs alternately press while the armature is being turned. The other end of the armature-coil is connected with the other side of the main-line circuit.

It is well known that when calling-generators are operated a current of one polarity is generated during one half of the revolution of the armature and a 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 a current of one polarity and the other takes a current of the other polarity.

It is apparent from the above description of the apparatus and connections that when the generator is being operated and the key is not depressed a current of one polarity will go to the line-circuit, but when the key is depressed a current of the other polarity will go to line.

The line-annunciators should preferably be polarized annunciators and should preferably be connected in their respective line-circuits in such a direction that they are operated when the subscriber's generator is turned and his key not depressed. The clearing-out annunciators of the exchange may be ordinary non-polarized annunciators.

The operation of the system is as follows: When a subscriber desires to send in a call, he will operate his generator without depressing on his key and his annunciator will indicate a call. The operator at the board where the call is indicated then places plug D' of a pair of her plugs into the switch of the line 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 and 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, D, 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, she tests the line by placing the contact-piece *i* of her test-plug in connection with that contact of the switch which is connected with the line, and if the line tests "free" or "not in use" she places the other plug of the pair of plugs she is using for the connection 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 the plug is inserted into a switch in such a direction that

its piece *m* forms connection with one of the contact-pieces of the switch the piece *m'* of the plug is then in connection with the other contact-piece 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 the operator on receiving the call of a line finds that a switch-plug is already in the switch of the line, she connects with the line through the switching device of the plug. When a subscriber desires to send a clearing-out signal, he presses on his key 5 and operates his generator, and a current will go to the circuit, which will operate the clearing-out annunciator in the circuit. This current is, however, of the opposite polarity of the current which operates her line-annunciator; otherwise that annunciator might indicate and give a false signal that the subscriber desired a connection. The clearing-out system comprehends, therefore, clearing-out annunciators that respond to clearing-out signals and line-annunciators that only respond to calling-currents transmitted by subscribers. Thus the line-annunciators may be polarized and the calling-currents be of a character to operate them, while the clearing-out annunciators may be oppositely polarized or neutral, so that they respond to clearing-out currents that do not affect the calling-annunciators. The different polarized annunciators should be connected in the same direction in their respective circuits.

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 in testing. 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 therefore not indicate she will know that the line is free to be connected to.

It will be seen that when two lines are con-

nected together for conversation the circuit is connected to ground at the central office through the annunciator 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-circuits. The annunciators themselves have so much retardation that in certain places it may 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 line-annunciator and retardation-coil. These last should be of such resistance that when the signal is thus made there will not enough current pass through them to operate the annunciator.

In the system which I have shown line-annunciators are placed with the retardation-coils in the ground connections of the lines. Certain features of my invention are applicable to exchanges in which annunciators are not used and connected, as shown and described, in the circuit with the retardation-coils. For instance, the annunciators need not be used and the calls may be sent to the central office by means of special calling circuits and systems, as in the well-known Law and American district systems. The advantage in such a system of operation in having the lines grounded at the central office is that there is less inductive disturbance in telephone-exchanges in which the lines are normally on closed circuit than in exchanges in which the lines are normally on open circuit. By the use of the retardation-coils the lines may be left permanently grounded at the central office and on closed circuit without injurious effect on the general operation of the exchange.

With this system and organization for multiple switchboards only one-half as many switches are required for a given number of lines and twice as many lines can be placed in a given space as in the usual multiple switchboard system. It therefore doubles the capacity of a given-sized multiple switchboard.

The system of switching herein shown and described is like that of my application Serial No. 383,002, from which this case is distinguished by the use of annunciators or retardation-coils in the ground connections of the line at the central office.

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

1. In a telephone-exchange system, telephone-lines divided into pairs, annunciators for said lines, one annunciator for each line, and switches for said lines on a switchboard, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected,

and each line being grounded through its annunciator, in combination with pairs of switch-plugs, the plugs having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit, and a test-battery in each of such conducting-circuits, each plug being adapted to be inserted into each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with the other contact-piece of the switch, substantially as set forth.

2. In a telephone-exchange system, telephone-lines divided into pairs, retardation-coils for said lines one retardation-coil for each line and switches for said lines on a switchboard, one switch for each pair of lines each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being grounded through its retardation-coil, in combination with pairs of switch-plugs, the plugs having each a contact-piece the two contact-pieces of a pair being connected by a flexible conducting-circuit, and a test-battery in each of such conducting-circuits, each plug being adapted to be inserted into each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with the other contact-piece of the switch, substantially as set forth.

3. In a telephone-exchange system, telephone-lines divided into pairs, annunciators and retardation-coils for said lines, one annunciator and one retardation-coil for each line, and switches for said lines on a switchboard, each switch having two contact-pieces to which the two lines of its pair are respectively connected each line being grounded through its annunciator and retardation-coil, in combination with pairs of switch-plugs, the plugs having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit, and a test-battery in each of such conducting-circuits, each plug being adapted to be inserted in each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is connected with the other contact-piece of the switch, substantially as set forth.

4. In a telephone-exchange system, telephone-lines grounded at their outer ends and divided into pairs, annunciators for said lines, one annunciator for each line and switches for said lines on a switchboard, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line grounded through its annunciator, in combination with pairs of switch-plugs, the plugs

having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit, a test-battery in each of such conducting-circuits, each plug being adapted to be inserted into each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with the other contact-piece of the switch, and a test receiving instrument grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with either of said lines, substantially as set forth.

5. In a telephone-exchange system, telephone-lines grounded at their outer ends and divided into pairs retardation-coils for said lines, one retardation-coil for each line and switches for said lines, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line grounded through its retardation-coil, in combination with pairs of switch-plugs, the plugs having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit, each plug being adapted to be inserted into each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with the other contact-piece of the switch, a test-battery in each of such flexible conducting-circuits, and a test receiving instrument grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with either of said lines, substantially as set forth.

6. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at their outer ends and divided into pairs, annunciators for said lines, one annunciator for each line and switches for said lines, one switch for each pair of lines on each of said boards, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being also grounded through its annunciator, in combination with pairs of switch-plugs at each board, the plugs having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit each plug being adapted to be inserted into each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with the other contact-piece of the switch, a test-battery in each of said flexible conducting-circuits, and test receiving instruments, one at each board, each grounded on one side and connected on its

other side to a plug or device adapted to be brought into connection with any of said contact-pieces of said switches at its board, substantially as set forth.

5 7. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at their outer ends and divided into pairs, annunciators and retardation-coils for said lines, one annunciator and one retardation-coil for
10 each line, and switches for said lines, one switch for each pair of lines on each of said boards, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being also grounded
15 through its annunciator and retardation-coil, in combination with pairs of switch-plugs at each board, the plugs having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit, each plug being adapted to be inserted into
20 each switch in two positions or directions, in one of which said contact-piece of the plug is in connection with one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with
25 the other contact-piece of the switch, a test-battery in each of said flexible conducting-circuits, and test receiving instruments one at each board, each grounded on one side and
30 connected on its other side to a plug or device adapted to be brought into connection with any of said contact-pieces of said switches at its board, substantially as set forth.

35 8. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at their outer ends and divided into pairs, retardation-coils for said lines, one retardation-coil for each line, and switches for said lines, one switch for each pair of lines on each board,
40 each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being also grounded through its retardation-coil, in combination with pairs of switch-plugs at each board, the
45 plugs having each a contact-piece, the two contact-pieces of a pair being connected by a flexible conducting-circuit each plug being adapted to be inserted into each switch in two directions or positions, in one of which said contact-piece of the plug is in connection with
50 one of the contact-pieces of the switch and in the other of which said contact-piece of the plug is in connection with the other contact-piece of the switch, a test-battery in each of said flexible conducting-circuits, and test receiving instruments, one at each board, each grounded on one side and connected on its
55 other side to a plug or device adapted to be brought into connection with any of said contact-pieces of said switches at its board, substantially as set forth.

9. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at their outer ends and divided into pairs, annunciators for said lines, one annunciator for each

line, and switches for said lines one switch for each pair of lines on each board, each switch having two contact-pieces to which the two lines of its pair are respectively connected, each line being also grounded through its annunciator, in combination with pairs of switch-plugs at each board, the plugs having each a contact-piece and said contact-pieces of a pair being connected together by a flexible conducting-circuit, each plug having also a second contact-piece and a switching device located at its board with a contact-piece connected by a flexible conductor with said second contact-piece of the plug, each plug being adapted to be inserted into each switch in two positions or directions, in one of which its said first-mentioned contact-piece is connected with one of the contact-pieces of the switch, and its said second-mentioned contact-piece is connected with the other contact-piece of the switch and in the other position of which said first-mentioned contact-piece of the plug is in connection with said second-mentioned contact-piece of the switch and said second-mentioned contact-piece of the plug is in connection with said first-mentioned contact-piece of the switch, each plug being also adapted to be inserted into each of said switching devices at its board, and when inserted to connect its said first-mentioned contact-piece with said contact-piece of the switching device, substantially as set forth.

10. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at their outer ends and divided into pairs, retardation-coils for said lines, one retardation-coil for each line, and switches for said lines, one switch for each pair of lines on each of said boards, each switch having two contact-pieces to which the two lines of its pair are respectively connected, each line being also grounded through its retardation-coil in combination with pairs of switch-plugs at each board, the plugs having each a contact-piece and said contact-pieces of a pair being connected together by a flexible conducting-circuit, each plug having also a second contact-piece and a switching device located at its board with a contact-piece connected by a flexible conductor with said second contact-piece of the plug, each plug being adapted to be inserted into each switch in two positions or directions, in one of which its said first-mentioned contact-piece is connected with one of the contact-pieces of the switch and its said second-mentioned contact-piece is connected with the other contact-piece of the switch and in the other position of which said first-mentioned contact-piece of the plug is connected with said second-mentioned contact-piece of the switch and said second-mentioned contact-piece of the plug is connected with said first-mentioned contact-piece of the switch, each plug being also adapted to be inserted into each of said switching devices at its board and

when inserted to connect its said first-mentioned contact-piece with said contact-piece of the switching device, substantially as set forth.

5 11. In a telephone-exchange system, multiple switchboards, telephone-lines grounded at
their outer ends and divided into pairs, annun-
ciators for said lines, one annunciator for each
10 for each pair of lines on each of said boards,
each switch having two contact-pieces to which
the two lines of its pair are respectively con-
nected, and each line being also grounded
through its annunciator, in combination with
15 pairs of switch-plugs at each board, the plugs
having each a contact-piece and said contact-
pieces of a pair being connected together by
a flexible conducting-circuit, each plug having
20 also a second contact-piece and a switching
device located at its board with a contact-piece
connected through a flexible conductor with
said second contact-piece of the plug, each
plug being adapted to be inserted into said
25 switches in two positions or directions, in one
of which its said first-mentioned contact-piece
is connected with one of the contact-pieces of
the switch, and its second-mentioned contact-
piece is connected with the other contact-piece
30 of the switch and in the other position of
which the said first-mentioned contact-piece of
the plug is connected with the second-men-
tioned contact-piece of the switch and the sec-
ond-mentioned contact-piece of the plug is
35 connected with the first-mentioned contact-
piece of the switch, each plug being also adapt-
ed to be inserted into each of said switching
devices at its board and when inserted to con-
nect its contact-piece with said contact-piece
40 of the switching device, a test-battery in each
of said flexible conducting-circuits, and test
receiving instruments, one at each board, each
grounded on one side and connected on its
other side to a plug or device adapted to be
45 brought into connection with any of said con-
tact-pieces of said switches and switching de-
vices at its board, substantially as set forth.

12. In a telephone-exchange system, multi-
ple switchboards, telephone-lines grounded at
50 their outer ends and divided into pairs, retard-
ation-coils for said lines, one for each line,
and switches for said lines, one switch for each
pair of lines on each of said boards, each
switch having two contact-pieces to which the
two lines of its pair are respectively connected,
55 and each line being also grounded, through its
retardation-coil, in combination with pairs of
switch-plugs at each board, the plugs having
each a contact-piece and said contact-pieces of
a pair being connected together by a flexible
60 conducting-circuit, a test-battery in each of
said flexible conducting-circuits, each plug
having also a second contact-piece and a switch-
ing device located at its board with a contact-
piece connected through a flexible conductor
65 with said second contact-piece of the plug,

each plug being adapted to be inserted into
each switch at its board in two positions or
directions, in one of which its said first-men-
tioned contact-piece is connected with one of
70 the contact-pieces of the switch and its said sec-
ond-mentioned contact-piece is connected with
the other contact-piece of the switch and in the
other of which its said first-mentioned con-
tact-piece is connected with the second-men-
75 tioned contact-piece of the switch and its said
second-mentioned contact-piece is connected
with the first-mentioned contact-piece of the
switch, each plug being also adapted to be
inserted into each of said switching devices at
80 its board and when inserted to connect said
first-mentioned contact-piece of the plug with
said contact-piece of the switching device,
and test receiving instruments, one at each
board, each grounded on one side and con-
85 nected on its other side to a plug or device
adapted to be brought into connection with any
of said contact-pieces of said switches and
switching devices at its board, substantially as
set forth.

13. In a telephone-exchange system, multi- 90
ple switchboards, telephone-lines divided into
pairs, annunciators for said lines, one annun-
ciator for each line, and switches for said
lines, one switch on each board for each pair
95 of lines, each switch having two contact-pieces
to which the two lines of its pair are respec-
tively connected and each line being ground-
ed through its annunciator, in combination
with two switch-plugs at any board, the con-
100 tact-pieces of which are connected together by
flexible conductors, said plugs being inserted
into two of said switches to connect together
two of said lines for conversation between the
subscribers into a circuit which does not in-
105 clude their annunciators, and a clearing-out
annunciator in circuit with either or both lines
thereby connected together, substantially as
set forth.

14. In a telephone-exchange system, multi- 110
ple switchboards, telephone-lines divided into
pairs, retardation-coils for said lines, one re-
tardation-coil for each line and switches for
said lines, one switch on each board for each
pair of lines, each switch having two contact-
115 pieces to which the two lines of its pair are
respectively connected and each line being
grounded through its retardation-coil, in com-
bination with two switch-plugs at any board,
the contact-pieces of which are connected to-
120 gether by flexible conductors, said plugs being
inserted into two of said switches to connect
together two of said lines for conversation be-
tween the subscribers into a circuit which
does not include their retardation-coils, and a
125 clearing-out annunciator in circuit with either
or both lines thereby connected together, sub-
stantially as set forth.

15. In a telephone-exchange system, multi-
ple switchboards, telephone-lines divided into
pairs, annunciators and retardation-coils for 130

said lines, one annunciator and one retardation-coil for each line and switches for said lines, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being grounded through its annunciator and retardation-coil, in combination with two switch-plugs at any board, the contact-pieces of which are connected together by flexible conductors, said plugs being inserted into two of said switches to connect together two of said lines for conversation between the subscribers into a circuit which does not include their annunciators and retardation-coils, and a clearing-out annunciator in circuit with either or both lines thereby connected together, substantially as set forth.

16. In a telephone-exchange system, the combination of telephone-lines, a generator and apparatus at each subscriber's station to at will generate two kinds of currents, a calling-current and a clearing-out current, their switching devices on a board of the exchange, annunciators for the lines each in a connection from its line to ground and adapted to respond to calling-currents, but not to clearing-out currents, means for connecting two lines together for a conversation, a clearing-out annunciator, means for connecting it in the direct circuit of two connected lines, said annunciator being adapted to respond to clearing-out currents, substantially as set forth.

17. In a telephone-exchange system, the combination of two telephone-lines connected together for conversation, their calling-annunciators through which they are each permanently grounded, and a clearing-out annunciator connected in the direct circuit of two connected lines, the calling-annunciators being adapted not to respond to clearing-out currents, substantially as set forth.

18. In a telephone-exchange system, the combination of telephone-lines, multiple switchboards, switch devices for each line on each board, a polarized annunciator for each line connected at the central office in a connection from its line to ground, devices at each subscriber's station for sending currents over the line of one polarity to operate the line-annunciator, means for connecting two lines together for conversation, a clearing-out annunciator at the central office, circuit connections whereby it is included in the direct circuit of two connected lines, and means whereby either subscriber may send over the line a current of the other polarity that will not operate the calling-annunciators, but will operate the clearing-annunciator, substantially as set forth.

19. In a telephone-exchange system, the combination of two telephone-lines connected together for conversation, their calling-annunciators through which they are then, or as long as thus connected, grounded, and a clearing-out

annunciator connected in the direct circuit of said lines, the calling-annunciators being adapted not to respond to clearing-out currents, substantially as set forth.

20. In a telephone-exchange system, telephone-lines divided into pairs, annunciators for said lines, one annunciator for each line, and switches for said lines, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being grounded through its annunciator, in combination with pairs of switch-plugs, the plugs having each a contact-piece and the two contact-pieces of each pair being connected together by a flexible conducting-circuit, each plug being adapted to be inserted into each switch in two positions or directions, in one of which its said contact-piece is connected with one of the contact-pieces of the switch and in the other of which the contact-piece of the plug is connected with the other contact-piece of the switch, substantially as set forth.

21. In a telephone-exchange system, telephone-lines divided into pairs, annunciators and retardation-coils for said lines, one annunciator and one retardation-coil for each line, and switches for said lines on a switchboard, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being grounded through its annunciator and retardation-coil, in combination with pairs of switch-plugs, the plugs having each a contact-piece and the two contact-pieces of each pair being connected together by a flexible conducting-circuit, each plug being adapted to be inserted into each switch in two positions or directions, in one of which its said contact-piece is connected with one of the contact-pieces of the switch and in the other of which the contact-piece of the plug is connected with the other contact-piece of the switch, substantially as set forth.

22. In a telephone-exchange system, telephone-lines divided into pairs, annunciators for said lines, one annunciator for each line, and switches for said lines on a switchboard, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected each line being grounded through its annunciator, in combination with pairs of switch-plugs having each a contact-piece and said contact-pieces of a pair being connected by a flexible conducting-circuit, each plug having also a second contact-piece and a switching device with a contact-piece to which said second contact-piece of the plug is connected by a flexible conducting-circuit, each plug being adapted to be inserted into each switch in two positions or directions, in one of which its first-mentioned contact-piece is connected to one of the contact-pieces of the switch and its second-mentioned contact-piece is connected

with the other contact-piece of the switch, and in the other of which the first-mentioned contact-piece of the plug is connected with the second-mentioned contact-piece of the switch and the second-mentioned contact-piece of the plug is connected with the first-mentioned contact-piece of the switch, each plug being also adapted to be inserted into each of said switching devices and when inserted to connect its first-mentioned contact-piece with said contact-piece of the switching device, substantially as set forth.

23. In a telephone-exchange system, telephone-lines divided into pairs, annunciators and retardation-coils for said lines, one annunciator and one retardation-coil for each line, and switches for said lines on a switchboard, each switch having two contact-pieces to which the two lines of its pair are respectively connected, each line being grounded through its annunciator and retardation-coil, in combination with pairs of switch-plugs, the plugs having each a contact-piece and said contact-pieces of a pair being connected by a flexible conducting-circuit, each plug having also a second contact-piece and a switching device with a contact-piece connected with said second contact-piece of the plug through a flexible conducting-circuit, each plug being adapted to be inserted in two positions or directions in each switch, in one of which positions said first-mentioned contact of the plug is connected to one of the contact-pieces of the switch and said second-mentioned contact-piece of the plug is connected with the other contact-piece of the switch, and in the other of which said first-mentioned contact-piece of the plug is connected with said second-mentioned contact-piece of the switch and said second-mentioned contact-piece of the plug is connected with said first-mentioned contact-piece of the switch, each plug being also adapted to be inserted into each of said switching devices, and when inserted, to connect its first-mentioned contact-piece with said contact-piece of the switching device, substantially as set forth.

24. In a telephone-exchange system, telephone-lines divided into pairs, annunciators for said lines, one annunciator for each line, and switches for said lines, one switch for each

pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected and each line being grounded through its annunciator, in combination with two switch-plugs, the two contact-pieces of which are connected together by flexible conductors, said plugs being inserted into two of said switches to connect two of said lines for conversation between the subscribers into a circuit which does not include their annunciators, substantially as set forth.

25. In a telephone-exchange system, telephone-lines, divided into pairs, retardation-coils for said lines, one retardation-coil for each line, and switches for said lines one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected, and each line being grounded through its retardation-coil, in combination with two switch-plugs, the two contact-pieces of which are connected together by flexible conductors, said plugs being inserted into two of said switches to connect two of said lines for conversation between the subscribers into a circuit which does not include their retardation-coils.

26. In a telephone-exchange system, telephone-lines divided into pairs, annunciators and retardation-coils for said lines, one annunciator and one retardation-coil for each line, and switches for said lines, one switch for each pair of lines, each switch having two contact-pieces to which the two lines of its pair are respectively connected and each line being grounded through its annunciator and retardation-coil, in combination with two switch-plugs, the two contact-pieces of which are connected together by flexible conductors, said plugs being inserted into two of said switches to connect two of said lines for conversation between the subscribers into a circuit which does not include their annunciators and retardation-coils.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:

FRANK S. OBER,
EDWARD C. DAVIDSON.