

(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,419.

Patented Oct. 26, 1897.

Fig. 1.

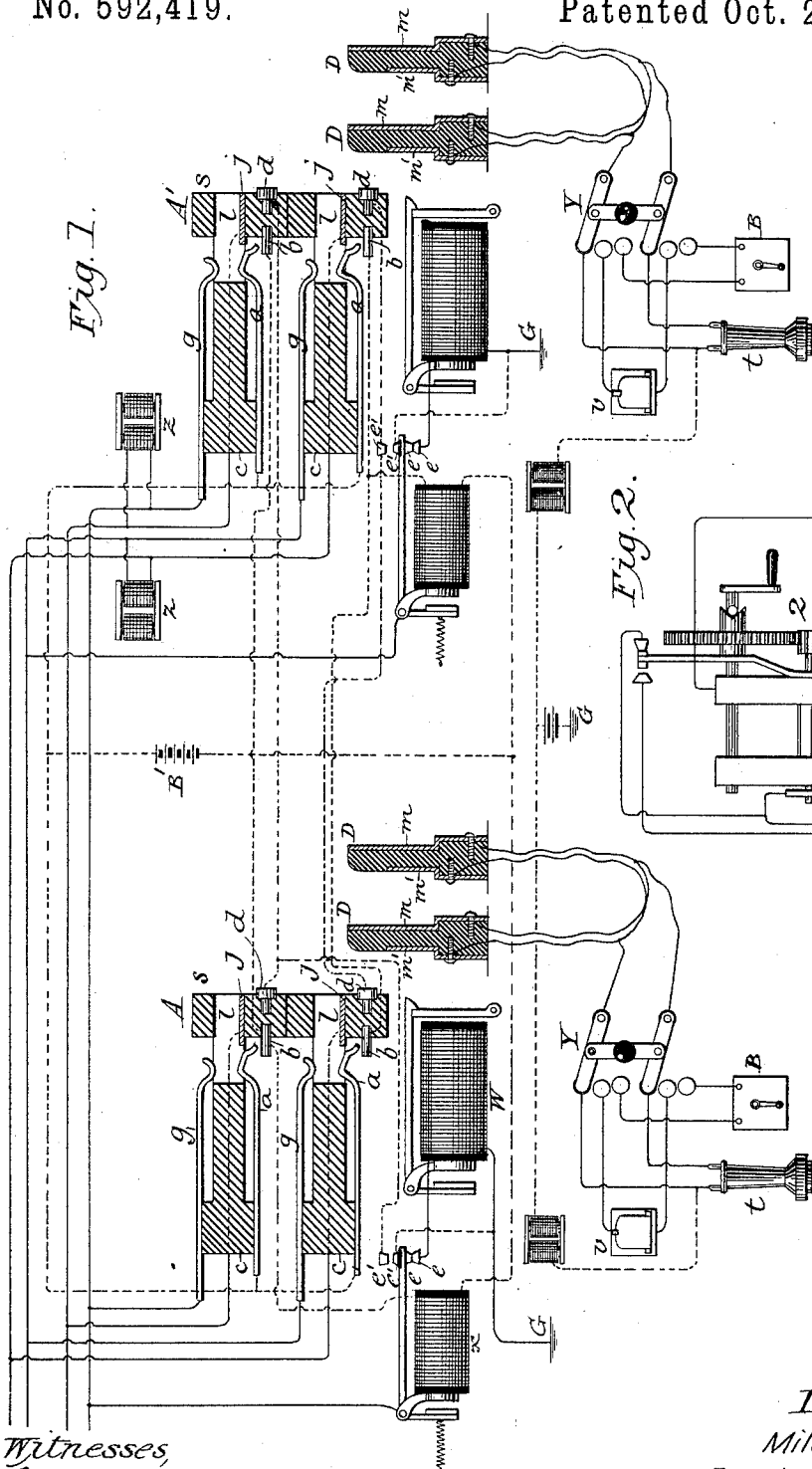
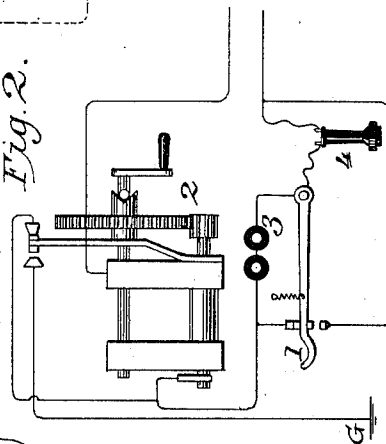


Fig. 2.



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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,419, dated October 26, 1897.

Application filed February 12, 1895. Serial No. 538,136. (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 especially to a telephone-exchange system in which the lines are metallic-circuit lines.

My invention consists in a system of calling, answering calls, switching, testing, and clearing-out signals which I shall describe and claim in detail.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram of the central-office apparatus and connections, and Fig. 2 is a diagram of the subscriber's-station apparatus necessary to illustrate my invention.

In Fig. 1 two multiple switchboards (marked A A') are shown. As many other switchboards may be used as is necessary for the size and character of the exchange. Each board has a switch or line terminal for each line of the exchange. The switches are marked *s s*. Each switch is adapted to receive the loop-switch plugs (marked D D) and has two contact-pieces *g j*, with which, respectively, the two contact-pieces *m m'* of the plug form contact when the plug is inserted. Each switch has also an insulated test-contact (marked *d*) which is placed at or near the front of the switch, so that a plug contact-piece may be applied to it for testing. Each switch has also two contacts *a b*, which are insulated from the rest of the switch parts and are normally (or when a plug is not in the switch) not in contact with each other.

U are the switch-holes into which the switch-plugs D D may be placed for switching the lines together.

c c are the rubber pieces, suitably shaped, on which the metal parts of the switches are respectively mounted.

g j may be called the "main-line contacts" of the switch, because they are connected with the circuit of the main line, and *a b* may

be called the "local contacts" of the switch, because they are used in a circuit which is local to the central office of the exchange.

The switch-plugs D D have each two contacts *m m'*. When a plug is inserted into a switch, its contact-piece *m* forms connection with the contact-piece *g* of the switch and its contact-piece *m'* forms connection with the contact-piece *j* of the switch, while the insulated piece of the plug forces the contact-piece *a* of the switch into contact with the contact-piece *b* of the switch, but *a* and *b* are not in electric connection with the contact-pieces *g j* of the switch. The switches and the plugs are so shaped and constructed as to produce the switching operations above described. They may, however, be shaped and constructed in other ways, so as to produce substantially the same switching operations. In the construction and arrangement shown there are two contact-pieces of the switch with which the two contact-pieces of the plug respectively form connection when the plug is inserted and two other contact-pieces of the switch which are insulated from said first-mentioned contact-pieces and are normally unconnected with each other, (except through the circuit connections,) but are brought into electrical connection when a plug is inserted into the switch.

Each line has an annunciator marked *w*, a retardation-coil marked *z*, and a relay marked *x*.

Each relay may be of any suitable construction, with a pair of contact-points which are normally, or when no current is passing through the relay-magnet, closed, but are opened when the magnet is energized by being included in closed circuit with a battery of suitable character. It has also another pair of contacts which are normally open, but are closed when the relay is energized. These pairs of contacts are marked *e e* and *e' e'*, respectively. The relay and annunciator of each line may be conveniently mounted in juxtaposition—as, for instance, on the same frame or support—with the relay in the rear of the annunciator, the drop of the latter being, of course, at the front of the switchboard.

The two contact-pieces *g j* of each line-switch are the main-line contacts of the switch. One

side of each metallic-circuit line is connected to one of these contact-pieces—say *j*—of each switch of the line, and the other side of the line is connected to the other contact-pieces of the line—say *g*.

One side of the line is normally grounded at the central office through the normally closed pair of contacts *ee* of the relay and through the annunciator of the line.

The two sides of the line are bridged or connected together at the central office through the retardation-coil of the line. This bridge connection through the retardation-coil should preferably be made at or close to the switchboard which is connected to the line farthest from the subscriber's station.

The line-annunciators are distributed among the various boards and at boards where the calls of the lines are to be answered.

Each operator has as many pairs of plugs *DD* as she may need for her work.

The two contact-pieces *mm* of the plugs are connected together by a flexible conductor, and the two contact-pieces *m'm'* of the plugs are connected together by another flexible conductor.

Y is a looping-in switch having two levers and three pairs of contact-bolts, against which the two levers may alternately be placed in contact. There is one switch *Y* for each pair of plugs. The two levers are connected to the two flexible conductors, respectively, of the pair of plugs. The two bolts of one pair are connected together through the operator's telephone, (marked *t*.) The two bolts of another pair are connected together through the clearing-out annunciator of the pair of plugs. The two bolts of the third pair are connected together through the operator's calling-generator.

v is a clearing-out annunciator, of which there is one of each for each pair of plugs.

B' is a relay-battery, *B²* a test-battery, and *B* is a calling-generator, of which there may be one or more of each for the exchange.

One of the local contacts of each switch—say *a*—is connected with all of the contacts of the same kind—say *a*—of all of the other switches of the exchange. One side of the relay-battery *B'* is connected to the circuit connection which connects together all of these contact-pieces *aa* of the switches of the exchange. One side of each relay is connected to the other side of this relay-battery *B'*, and the other side of each relay is connected to all the contact-pieces *bb* of the switches of the line to which the relay belongs.

The test-contacts *dd* of each line are connected together and the circuit connection is connected to one of the normally open contacts *e'e'* of the relay, the other of which is grounded. That side of each operator's telephone which is connected to the switch-contacts which form connection with that lever of switches *Y* that is connected to the contacts *m'm'* of the switch-plugs is connected to one side of an individual retardation-coil,

while the other sides of the retardation-coils are connected to a common ground-wire which contains the test-battery *B²*.

For clearness of illustration the main lines and their circuit connections are indicated by solid lines and the local test and relay connections of the exchange are represented by broken lines.

The test-contact *d* of each switch is conveniently placed, so that one of the contacts of each switch-plug—say *m*—may be applied to it for testing.

The subscriber's-station apparatus may be of the ordinary construction used in telephone-exchanges and is in the metallic circuit of the line, but should have a pair of contacts which automatically ground the line when the generator is being operated, as will hereinafter be described.

The line-annunciators *ww* may be of the ordinary construction of non-polarized telephone-annunciators. The clearing-out annunciators *vv* may also be non-polarized and should preferably be of high resistance and retardation to telephone-currents.

Each operator's plug and cord apparatus should be conveniently mounted and arranged for her work.

In the subscriber's-station apparatus shown in Fig. 2, 1 is the telephone-switch; 2, the subscriber's calling-generator; 3, his signal-receiving bell, and 4 his telephone. The circuits are substantially as shown and such that when the telephone is on the switch the signal-receiving bell is in the circuit of the line and the telephone is shunted or short-circuited, and when the telephone is off from the switch it is in the circuit of the line and the signal-receiving bell is shunted or short-circuited.

The calling-generator is in the closed circuit of the line and has an automatic device or arrangement of the usual construction by which the generator-armature is normally short-circuited, but when the generator is being operated the short circuit is automatically opened or removed. The automatic device of the generator has also a pair of contacts and connections by which while the generator is being operated the line-circuit is automatically grounded on one side of the armature-coil.

The subscriber's-station apparatus should be connected into the line-circuit in such a direction that when it is operated and the ground connection of the line is thereby automatically established, as above described, the armature of the generator is in the closed ground-circuit thereby established and which includes the subscriber's line-annunciator located at the central office. This ground-circuit is from the ground connection automatically established by the operation of the generator through the armature-coil and that side of the line which is grounded through the line-annunciator. When the generator is operated and the normal ground connec-

tion of the line exists at the central office, the line-annunciator will therefore be operated or indicate a call.

The operation of the system is as follows:

5 A subscriber on operating his calling-generator to send in a call sends a current through his above-described calling ground-circuit and through his line-annunciator, which is then in said ground-circuit. The line-annunciator will therefore be operated and will indicate a call. The operator on observing the indication places one of her switch-plugs D into the switch of the line. By so doing she automatically closes the pair of contacts 10 *ab* of the switch. This brings the relay *x* of the line into closed circuit with the battery *B'*, and the relay being thereby energized its normally closed contact-points are opened and its normally opened contact-points are 15 closed and the ground connection of the line which contains the line-annunciator is opened and remains open as long as the plug remains in the switch. When the operator places the plug in the switch, the levers of the switch *Y*, which belong to the plug, are in the position where her telephone bridges across between the two contact-pieces of the plug, which is the normal position in which the switch should be left while the pair of plugs 20 are not in use for switching. The operator's telephone is therefore in closed circuit with the subscriber's metallic-circuit line and she by conversation finds out what connection the subscriber wishes. This closed circuit is established by the connection of the two contacts *mm'* of the plug (to which, respectively, the two sides of the operator's telephone are connected) with the two contacts *g* and *j*, respectively, of the switch, which, as stated before, are connected to the two sides of the line. 25

When the operator finds out what line is wanted, she tests the line wanted, as will hereinafter be indicated, and if she finds it "free" or unswitched she places the other plug *D* of the pair of plugs in the switch of the line 30 wanted. By so doing the contacts *ab* of that switch are also closed, and the relay of that line being thereby brought into closed circuit with the battery *B'* is energized, and the ground connection of that line through the line-annunciator is also opened by the opening of the pair of contacts of the relay of the line and the normally open contacts are at the same time closed. The operator then moves the levers of the switch *Y* so that the calling-generator *B* is bridged across between the two conductors of the pair of plugs. Calling-current therefore goes in split or derived circuit through the metallic circuit of both lines 35 and will ring the bell of the subscriber wanted. The operator then places the lever of the switch *Y* so that the clearing-out annunciator *v* of the pair of plugs is bridged across between the two conductors of the pair of plugs. 40 The two lines are then connected together into metallic circuit for conversation with the

clearing out annunciator bridged across their combined circuit.

When the subscribers are through conversation, either of them may operate his calling-generator and send a current which will pass through the clearing-out annunciator and operate it. As the line-annunciators are out of circuit with the calling-generator when the clearing-out signal is sent (the circuit through the annunciators being opened by the pairs of contacts of the line-relays) no current will pass through the line-annunciators. For the same reason no current will pass through the line-annunciators when the operator sends the calling-current to line, as before indicated. The line-annunciator of the two lines will therefore not be operated either when the operator sends a calling-signal or either subscriber sends the clearing-out signal. 70 75 80 85

When the operator receives the clearing-out signal, she removes the plugs from the switches of the two lines. The closed contacts between *a* and *b* of the two switches are thereby automatically opened and the armatures of the relays of the two lines will take their normal positions, closing the ground connections which contain their respective annunciators and opening the contacts *e'e'* of the test system. The lines are thereby automatically in condition to receive calls from the subscribers. 90 95

The test system is as follows: When an operator desires to test any line, she places the contact *m* of one of her switch-plugs into contact with the contact-piece *d* of the line-switch, the switch *Y* of the plug having its levers in connection with her telephone. If the line is switched for conversation at any board, a complete circuit is thereby established which contains her telephone and the battery *B²*, and the telephone will respond or click, indicating that the line is switched for use. This complete circuit may be traced as follows: from the contact-piece *m* of the plug, through the cord conductor and switch-lever, through one coil of her telephone, thence through the retardation-coil, and thence through the battery *B²* to ground, thence through the contacts *e'e'* at the relay and thence to the contact *d*, to which the contact-piece *m* is applied for testing. If the line is not switched at any board, no such complete circuit will be established on testing because the contacts *e'e'* are open to each other and the telephone will not sound. The operator can therefore determine on testing whether or not a line is switched for use. 100 105 110 115 120

The drawings and the description heretofore made are for metallic-circuit lines only. The system is, however, adapted to ground-circuit lines or to a mixed system of metallic and ground circuit lines. To adapt it for such a system, the circuits and operation will be exactly as heretofore described, except that the ground-circuit lines are connected to one 125 130

of the contacts—say g —of each of their line-switches and the circuit connection which connects the other contacts $j j$ of these switches is connected to ground.

5 It is well known that when the lines of a telephone-exchange are normally on closed circuit there is less induction and electrical disturbance between the different lines of the exchange than when they are normally on
10 open circuit. By the use of retardation-coils, as described and shown, each line is normally on closed circuit and the electrical advantages above mentioned are maintained. It is also well known that open-circuit connections in the central-office wiring when attached to lines which are in use are liable to
15 produce induction effect on other circuits. By placing the retardation-coils of each line in a bridge which is formed at or close to the
20 switchboard which is connected to the line farthest from the subscriber's station the open-circuit connections in the wiring of the exchange are substantially removed, and injurious inductive effects are thereby obviated.

25 On account of the very high retardation effect of retardation-coils to telephone-currents the bridges through the retardation-coils of a circuit established for conversation between two lines will have no appreciable
30 effect on the talking-current.

When a subscriber operates his calling-generator to send a calling-signal, the retardation-coil of his line is in circuit with his generator, as well as the line-annunciator. On
35 account of the high resistance of the retardation-coil to his calling-current very little of the current will, however, pass through the coil and most of it will pass through the line-annunciator, and enough will pass through
40 the annunciator to operate it; also, when a subscriber operates his calling-generator to send a clearing-out signal the retardation-coils of the two lines connected together are in circuit with his generator, as well as the
45 clearing-out annunciator. On account of the high resistance of the retardation-coils to the current generated very little of the current will pass through them and most of it will pass through the clearing-out annunciator.
50 The generator should be of such strength and the annunciators of such resistance in relation to the resistances of the retardation-coils that enough current will always pass through the annunciators to operate them.

55 It is evident that the calling and clearing-out system which I have herein described does not depend on the retardation-coils and that the exchange system herein described would operate the same, as far as the calling
60 and clearing-out system are concerned, should the retardation-coils with the bridges which contain them be omitted. My invention, as far as the calling and clearing-out and test systems are concerned, is therefore not limited to an exchange system which employs retardation-coils in the manner I have described.

It is also evident that in the calling and clearing-out system which I have described the subscriber performs the same operations
70 and in the same manner whether he sends a calling or a clearing-out signal, although the two signals pass over two circuits, the former being a ground-circuit through the line-annunciator and the latter being the metallic
75 circuit of the line through the clearing-out annunciator. Hence he will not get mixed in the manner of sending the signals, and hence, moreover, the clearing-out annunciator will be made to indicate when the line is
80 still switched for conversation and the subscriber not knowing that fact attempts to send a calling-signal. Thus the disconnection will be made so that the line will be in readiness for a repetition of the calling-signal.
85

I claim as my invention—

1. In a telephone-exchange system, metallic-circuit lines, a switchboard, switches, one switch on said board for each line, each switch having two contact-pieces to which respectively the two sides of its line are connected,
90 means at said board to connect any two of said lines into a metallic circuit for conversation by joining together the two contact-pieces respectively of their switches, and a clearing-out annunciator in a bridge or cross
95 connection between the two sides of said circuit so formed, in combination with a ground-circuit connection for each line between one of its two sides or branches and the ground,
100 and an annunciator for each line located in its said ground connection, electromagnetic apparatus for each line automatically operated by the switching of the line for conversation to open said ground-circuit connection
105 of its line, and a calling-generator at each subscriber's station, operated in a ground-circuit containing one side of the line and the line-annunciator to operate the annunciator while the line is not switched for conversation
110 to indicate the calling-signal, and in the metallic circuit of the two lines to operate the clearing-out annunciator to indicate the clearing-out signal when the line is switched for conversation.
115

2. In a telephone-exchange system, metallic-circuit lines, a switchboard, switches, one switch on said board for each line, each switch having two contact-pieces to which respectively the two sides of its line are connected,
120 means at said board to connect any two of said lines into a metallic circuit for conversation by joining together the two contact-pieces respectively of their switches, and a clearing-out annunciator in a bridge or cross
125 connection between the two sides of said circuit so formed, in combination with a ground-circuit connection for each line between one of its two sides or branches and the ground,
130 and an annunciator for each line located in its said ground connection, electromagnetic apparatus for each line automatically operated by the switching of the line for conversation to open said ground-circuit connection

of its line, and a calling-generator at each subscriber's station in two circuits whenever operated to send a calling-signal, one being a circuit which includes the line-annunciator, but is closed only when the line is not switched for conversation, and the other a circuit which includes the clearing-out annunciator, but is closed only when the line is switched for conversation, whereby the differentiation of signals is obtained by the same operation from the subscriber.

3. In a telephone-exchange system, metallic-circuit lines, a switchboard, switches, one switch on said board for each line, each switch having two contact-pieces to which respectively the two sides of its line are connected, means at said board to connect any two of said lines into a metallic circuit for conversation by joining together the two contact-pieces respectively of their switches, and a clearing-out annunciator in a bridge or cross connection between the two sides of said circuit so formed, in combination with a ground-circuit connection for each line between one of its two sides or branches and the ground, and an annunciator for each line located in its said ground connection, electromagnetic apparatus for each line automatically operated by the switching of the line for conversation to open said ground-circuit connection of its line, a calling-generator at each subscriber's station in the metallic circuit of the line whenever operated, and a ground connection at the subscriber's station for the line when the generator is operated with the generator between such ground connection and the normal ground of the line at the central office.

4. In a telephone-exchange system, metallic-circuit lines, a switchboard, switches, one switch on said board for each line, each switch having two contact-pieces to which respectively the two sides of its line are connected, a retardation-coil for each line in a bridge connection at the central office between the two sides of the line, means at said board to connect any two of said lines into a metallic circuit for conversation by joining together the two contact-pieces respectively of their switches, and a clearing-out annunciator in a bridge or cross connection between the two sides of said circuit so formed, in combination with a ground-circuit connection for each line between one of its two sides or branches and the ground, and an annunciator for each line located in its said ground connection, electromagnetic apparatus for each line automatically operated by the switching of the line for conversation to open said ground-circuit connection of its line, and a calling-generator at each subscriber's station, operated in a ground-circuit containing one side of the line and the line-annunciator to operate the annunciator while the line is not switched for conversation to indicate the calling-signal, and in the metallic circuit of the two lines to operate the clearing-out an-

nunciator to indicate the clearing-out signal when the line is switched for conversation.

5. In a telephone multiple exchange system, metallic-circuit lines, a switchboard, switches, one switch on said board for each line, each switch having two contact-pieces to which respectively the two sides of its line are connected, a retardation-coil for each line in a bridge connection between the two sides of the line at the board connected to the line farthest from the subscriber's station, means at said board to connect any two of said lines into a metallic circuit for conversation by joining together the two contact-pieces respectively of their switches, and a clearing-out annunciator in a bridge or cross connection between the two sides of said circuit so formed, in combination with a ground-circuit connection for each line between one of its two sides or branches and the ground, and an annunciator for each line located in its said ground connection, electromagnetic apparatus for each line automatically operated by the switching of the line for conversation to open said ground-circuit connection of its line, and a calling-generator at each subscriber's station, operated in a ground-circuit containing one side of the line and the line-annunciator to operate the annunciator while the line is not switched for conversation to indicate the calling-signal, and in the metallic circuit of the two lines to operate the clearing-out annunciator to indicate the clearing-out signal when the line is switched for conversation.

6. In a multiple telephone-exchange system, a telephone-line and switching apparatus at the central office to connect it at will with another line for conversation, in combination with a local circuit for the line automatically closed by the switching of the line for conversation, an electromagnetic relay and a battery in said closed circuit, said relay having two pairs of contacts, one normally closed, but opened while said local circuit is closed, the other normally open, but closed while said local circuit is closed, the line-annunciator normally in closed circuit with the first-mentioned pair of contacts, and a test receiving instrument and battery in a closed circuit, which contains the second pair of contacts when on testing said second pair of contacts is closed, but not otherwise.

7. In a multiple telephone-exchange system, a telephone-line, an annunciator for the same and switching apparatus at the central office to connect the line at will with another line for conversation, in combination with two local circuits for the line, one automatically closed by the switching of the line for conversation, and an electromagnetic relay and battery in said closed circuit, to make the annunciator inoperative while the line is thus switched, and the other a test-circuit automatically closed at one point by contact-points of said relay when the line is thus switched, said test-circuit being closed at its

other open point by the operator on testing the line, and a test receiving instrument and battery in said test-circuit.

8. In a multiple telephone-exchange system, a telephone-line and switching apparatus at the central office to connect it at will with another line for conversation, in combination with a local circuit for the line automatically closed by the switching of the line for conversation, an electromagnetic relay and a relay-battery in said closed circuit, said relay having two pairs of contacts, one normally closed, but opened while said local circuit is closed, the other normally open, but closed while said local circuit is closed, the line-annunciator normally in closed circuit with the first-mentioned pair of contacts, and a test receiving instrument and a test-battery (not the relay-battery) in a closed circuit, which contains the second pair of contacts, when on testing said second pair of contacts is closed, but not otherwise.

9. In a telephone-exchange system, multiple switchboards and telephone-lines connected to the same, in combination with local test-circuits, insulated and disconnected from the line-circuits, one for each line, each test-circuit containing derived or parallel circuits and a connection common to and in series with said derived or parallel circuits, said common connection being normally open at a single point, said point being common to the boards, but closed at that point whenever the line is

switched for conversation at either board, said derived or parallel circuits of said test-circuit, one for each board, being each normally open, but closed by the operator on testing, a different test receiving instrument in each of said derived or parallel circuits, and battery in any test-circuit established on testing.

10. In a telephone-exchange system, multiple switchboards and telephone-lines connected to the same, in combination with local relay-circuits, one for each line, each normally open, but closed while and whenever the line is switched for conversation, a different relay and a battery in each of said circuits, local test-circuits, one for each line, each test-circuit being normally open at the relay of the line, but closed at that point while and whenever the line is switched for use at either board, derived or parallel circuits of said test-circuit, one for each board, each normally open, but closed by the operator on testing, a different test receiving instrument in each of said derived or parallel circuits, and battery in any test-circuit established on testing.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:

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