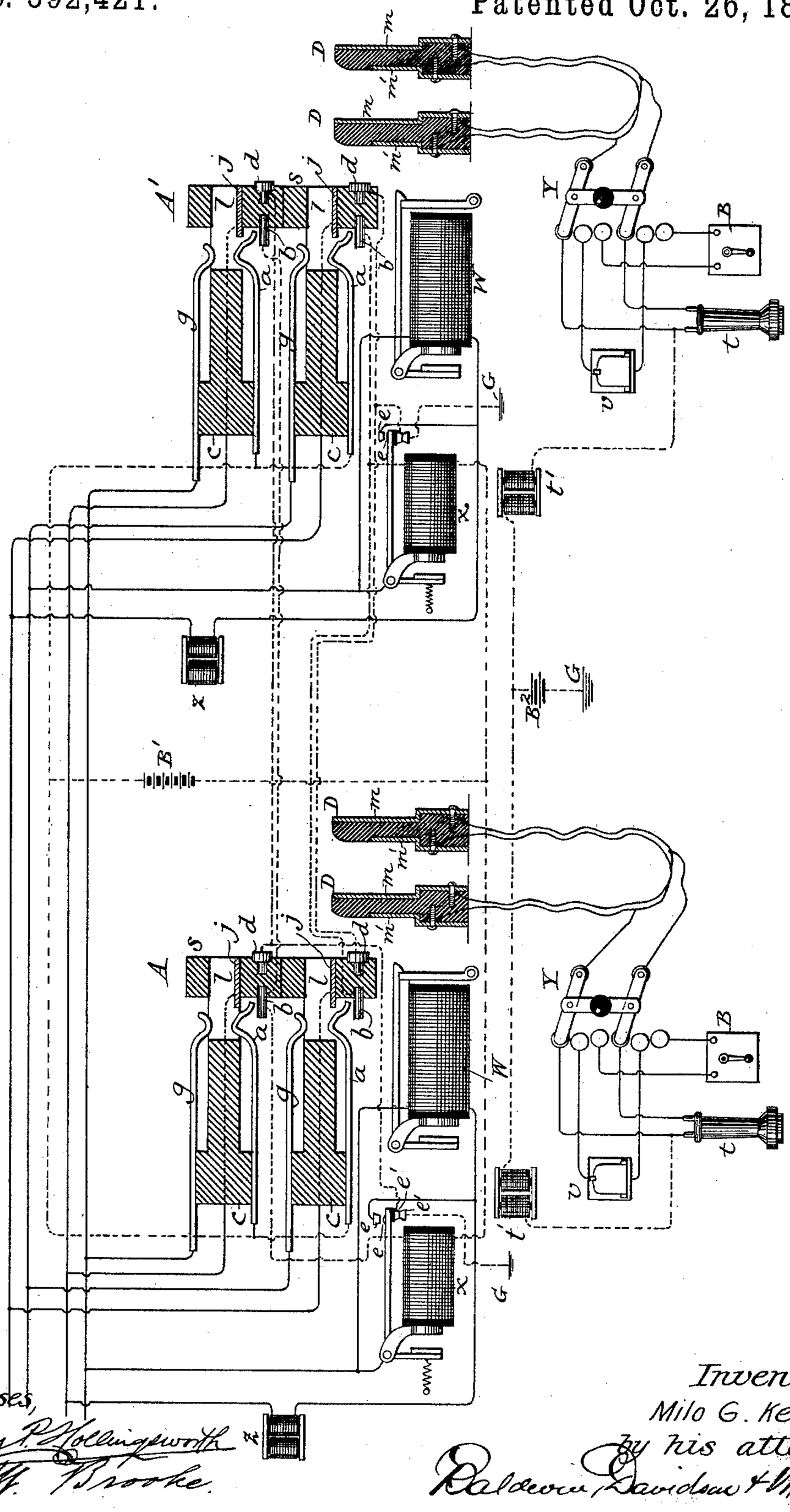
(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,421. Patented Oct. 26, 1897.



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UNITED STATES PATENT OFFICE.

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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,421, dated October 26, 1897.

Application filed February 12, 1895. Serial No. 538,138. (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 drawing, 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.

The accompanying drawing, illustrating my invention, is a diagram of the central-office apparatus and connections.

In the drawing 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 *d*, placed at or near the front of the switch and adapted to have a plug-contact 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.

l l 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* and *d* 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 and the test-contact *d*.

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, (marked *e e*,) which are normally (or when no current is passing through the relay-magnet) opened, but are closed when the magnet is energized by being included in closed circuit with a battery of suitable character, and another pair of contacts *e′ e′*, normally closed, but open while the relay is energized by being included in the closed circuit with the battery. 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*.

The two sides of the line are connected together at the central office through the annunciator and retardation-coil of the line and are therefore bridged or cross-connected by a bridge connection which contains the annunciator and retardation-coil.

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

One of the contacts of the normally open contacts *e e* of the relay of the line is connected to the bridge connection of the line above referred to on one side of the line-annunciator, and the other contact-piece of the pair is connected to the bridge connection on the other side of the annunciator.

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

The two contact-pieces *m m* 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, B^2 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 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 *a a* 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 *b b* of the switches of the line to which the relay belongs.

The side of the operator's telelephone which is connected to the switch-contacts which form connection with that lever of the switch Y which is connected to the contacts *m' m'* of the switch-plugs is connected to one side of a retardation-coil *z'* for the telephone. The other sides of the retardation-coils of the telephone are connected to a common wire, which is grounded, and which contains the test-battery B^2.

For clearness of illustration the main lines and their circuit connections are indicated by solid lines, and the local connections of the relay and test systems 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 test-contacts *d d* of a line are connected together and are connected to one of the normally closed contacts *e' e'* of the relay of the line. The other of the normally closed contacts *e' e'* of each relay is connected with the ground.

The subscriber's-station apparatus may be of the ordinary construction used in telephone-exchanges and is in the metallic circuit of the line.

The line-annunciators *w w* may be of the ordinary construction of non-polarized telephone-annunciators. The clearing-out annunciators *v v* 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.

The operation of the system is as follows: A subscriber on operating his calling-generator to send in a call sends a current through his metallic circuit and through his line-annunciator, which is then in a bridge between the two sides of his metallic-circuit line. 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 *a b* 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 contact-points are closed and the annunciator of the line is therefore shunted or short-circuited from the bridge connection across the two sides of the line, which, however, still contains the retardation-coil in its circuit and unshunted. At the same time the normally closed contacts *e' e'* are opened. When the operator places the plug in the switch, the levers of the switch Y, which belong to the plug, are in their normal position, which is the position where her telephone bridges across between the two contact-pieces of the plug. 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 *m m'* 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.

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 wanted. By so doing the contacts *a b* 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 annunciator in the bridge-circuit of that line is also short-circuited by the closing of the normally open pair of contacts of the relay of the line, while the normally closed pair is opened. 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 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. The two lines are then connected together into metallic circuit for conversation, with the clearing-out annunciator bridged across their combined circuits.

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 substantially out of circuit with the calling-generator when the clearing-out signal is sent, the annunciators being short-circuited by the pairs of contacts of the line-relays, substantially no current will pass through the line-annunciators. For the same reason substantially no current will pass through the line-annunciators when the operator sends the calling-current to line, as before indicated. The line-annunciators 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.

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, opening the shunts of their respective annunciators. The lines are thereby automatically in condition to receive calls from the subscribers.

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 *b* of the line-switch, the switch Y of the plug having its levers in connection with her telephone. If the line is not switched for conversation at any board, a complete circuit is thereby established which contains her telephone and the battery B^2, 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 her telephone and retardation-coil, thence through the battery B^2 to the ground, thence through the contacts *e′ e′* of the relay, and thence to the test-contact *d*, to which the contact-piece *m* is applied for testing. If the line is switched at any board, no such complete circuit will be established on testing, because the relay-contacts *e′ e′* are then opened and the telephone will not sound. The operator can therefore determine on testing whether or not a line is switched for use.

In the test system which has been described the sound is produced in the telephone when on the test being made the line is not switched for use, whereas in most test systems the sound is produced when on the test being made the line is switched for use. This is accomplished by having the switching of the line automatically open a pair of contacts of the test-circuit of the line which are normally (or when the line is not switched for use) closed, whereas in the other test systems referred to the test-circuit of a line is automatically closed at a pair of contacts when the line is switched. In this system, therefore, there is always a sound in the test receiving instrument when the line is tested and it is not switched, giving a prompt and positive indication that the operator may insert the switch-plug into the switch of the line.

The drawing 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 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.

The subscriber's calling-generators should of course be of such strength as to operate the line-annunciators when their lines are not switched and to operate the clearing-out annunciator when their lines are connected with other lines in a closed metallic circuit for conversation, and said closed circuit is bridged by a clearing-out annunciator, and the operator's calling-generator should be of such strength as to operate the subscribers' signal-receiving bells.

When two lines are connected together into a closed metallic circuit for conversation, the circuit is bridged at the central office through the retardation-coils of the two lines. On account of the great resistance of these coils to telephone-currents these bridge connections will not appreciably affect the conversation.

The local-circuit system, which contains the

relay and relay-battery of the line, is shown as entirely disconnected from the ground. It is preferable to have this relay system thus entirely disconnected from the ground, because it is well known that accidental ground connections are liable to occur on any system which is insulated from the ground. With the system as herein described it would require two accidental ground connections on the local relay-circuit of any line, one on one side of the relay and battery and the other on the other side of the relay and battery, in order to operate the relay and short-circuit the annunciator when the line itself was not switched.

I claim as my invention—

1. In a telephone-exchange system, telephone-lines, a switchboard and switching apparatus at the board to connect any two lines together for conversation, in combination with an annunciator and a retardation-coil for each line connected with it, an electromagnetic device for each line controlled by the switching apparatus of the line and contacts in said electromagnetic device of each line closed when the line is switched for conversation to short-circuit the annunciator but not the retardation-coil.

2. In a telephone-exchange system, telephone-lines, a switchboard and switching apparatus at the board to connect any two lines together, in combination with an annunciator and a retardation-coil for each line in a circuit connection between the direct and return conductors of the line, an electromagnetic device for each line controlled by the switching apparatus of the line and contacts in said electromagnetic device of each line closed when the line is switched for conversation to short-circuit the annunciator, but not the retardation-coil.

3. In a telephone-exchange system, metallic-circuit telephone-lines, a switchboard and switching apparatus at the board to connect any two lines together, in combination with an annunciator and a retardation-coil for each line in a bridge connection between the direct and return conductors of the line, an electromagnetic device for each line controlled by the switching apparatus of the line and contacts in said electromagnetic device of each line closed when the line is switched for conversation to short-circuit the annunciator, but not the retardation-coil.

4. In a telephone-exchange system, telephone-lines, a switchboard, a switch on the board for each line and switching apparatus, including plugs to be placed into the switches to connect any two lines together for conversation, a pair of contacts of each switch normally open, but closed when a plug is inserted into the switch, and a local circuit for each line closed by the said pair of contacts of its switch, and an electromagnetic device for the line and a battery in its said local circuit, in combination with an annunciator and a retardation-coil for each line in circuit with it, and contacts in said electromagnetic device for each line closed when the line is switched for conversation to short-circuit the annunciator, but not the retardation-coil.

5. In a telephone-exchange system, metallic telephone-lines, a switchboard, a switch on the board for each line, and switching apparatus, including plugs to be placed into the switches to connect any two lines together for conversation, a pair of contacts of each switch normally open, but closed when a plug is inserted into the switch, and a local circuit for each line closed by the said pair of contacts of its switch, and an electromagnetic device for the line and a battery in its said local circuit, in combination with an annunciator and a retardation-coil for each line in circuit with it, and contacts in said electromagnetic device for each line closed when the line is switched for conversation to short-circuit the annunciator, but not the retardation-coil.

6. In a telephone-exchange system, telephone-lines, a switchboard, a switch on the board for each line, and switching apparatus, including plugs to be placed into the switches to connect any two lines together for conversation, a pair of contacts of each switch normally open, but closed when a plug is inserted into the switch, and a local circuit for each line closed by the said pair of contacts of its switch, and an electromagnetic device for the line, and a battery in its said local circuit, in combination with an annunciator and a retardation-coil for each line in circuit between the direct and return conductors of the line, and contacts in said electromagnetic device for each line closed when the line is switched for conversation to short-circuit the annunciator, but not the retardation-coil.

7. In a telephone-exchange system, metallic-circuit telephone-lines, a switchboard, a switch on the board for each line, and switching apparatus, including plugs to be placed into the switches to connect any two lines together for conversation, a pair of contacts of each switch normally open, but closed when a plug is inserted into the switch, and a local circuit for each line closed by the said pair of contacts of its switch, and an electromagnetic device for the line, and a battery in its said local circuit, in combination with an annunciator and a retardation-coil for each line in a bridge connection between the direct and return conductors of the line, and contacts in said electromagnetic device for each line closed when the line is switched for conversation to short-circuit the annunciator, but not the retardation-coil.

8. In a multiple telephone-exchange system, telephone-lines, multiple switchboards, a switch on each board for each line and switching apparatus at the board to connect any two lines together, a pair of contacts for each line at each board normally open, but closed when the line is switched for conversation at the

board, and a local circuit for each line normally open, but closed by the said contacts of the line while the line is switched for conversation, in combination with an electromagnetic relay for each line and a battery in its local circuit, and two pairs of contacts in the relay, one normally open, but closed when the relay is energized and controlling the operation of the line-annunciator, and the other normally closed, but open when the relay is energized and controlling the test-signal of the line.

9. In a multiple telephone-exchange system, telephone-lines, multiple switchboards, a switch on each board for each line and switching apparatus at the board to connect any two lines together, a pair of contacts for each line at each board normally open, but closed when the line is switched for conversation at the board, and a local circuit for each line normally open, but closed by the said contacts of the line while the line is switched for conversation, in combination with an electromagnetic relay for each line, and a battery in its local circuit, and a pair of contacts of the test-circuit of the line in the relay normally closed, but open when the relay is energized and controlling the test-signal of the line.

10. In a multiple telephone-exchange system, a local circuit for each line normally open, but closed while the line is switched for conversation, in combination with an electromagnetic relay for each line, and a battery in its local circuit, a test-circuit for each line, said test-circuit being normally closed at a pair of contacts of the line's relay, but open while the relay is on closed circuit with its battery, said test-circuit being normally open at the point where the test is made, but closed then by the operator in testing, and a test receiving instrument and battery in said test-circuit.

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

12. In a multiple telephone-exchange system, a local circuit for each line normally open, but closed while the line is switched for conversation, in combination with an electromagnetic relay for each line, and a relay-battery in its local circuit, a test-circuit for each line, said test-circuit being normally closed at a pair of contacts of the line's relay, but open while the relay is on closed circuit with its battery, said test-circuit being normally open at the point where the test is made, but closed then by the operator in testing, and a test receiving instrument and a different battery (not the relay-battery) in said test-circuit.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
H. M. WALKER,
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