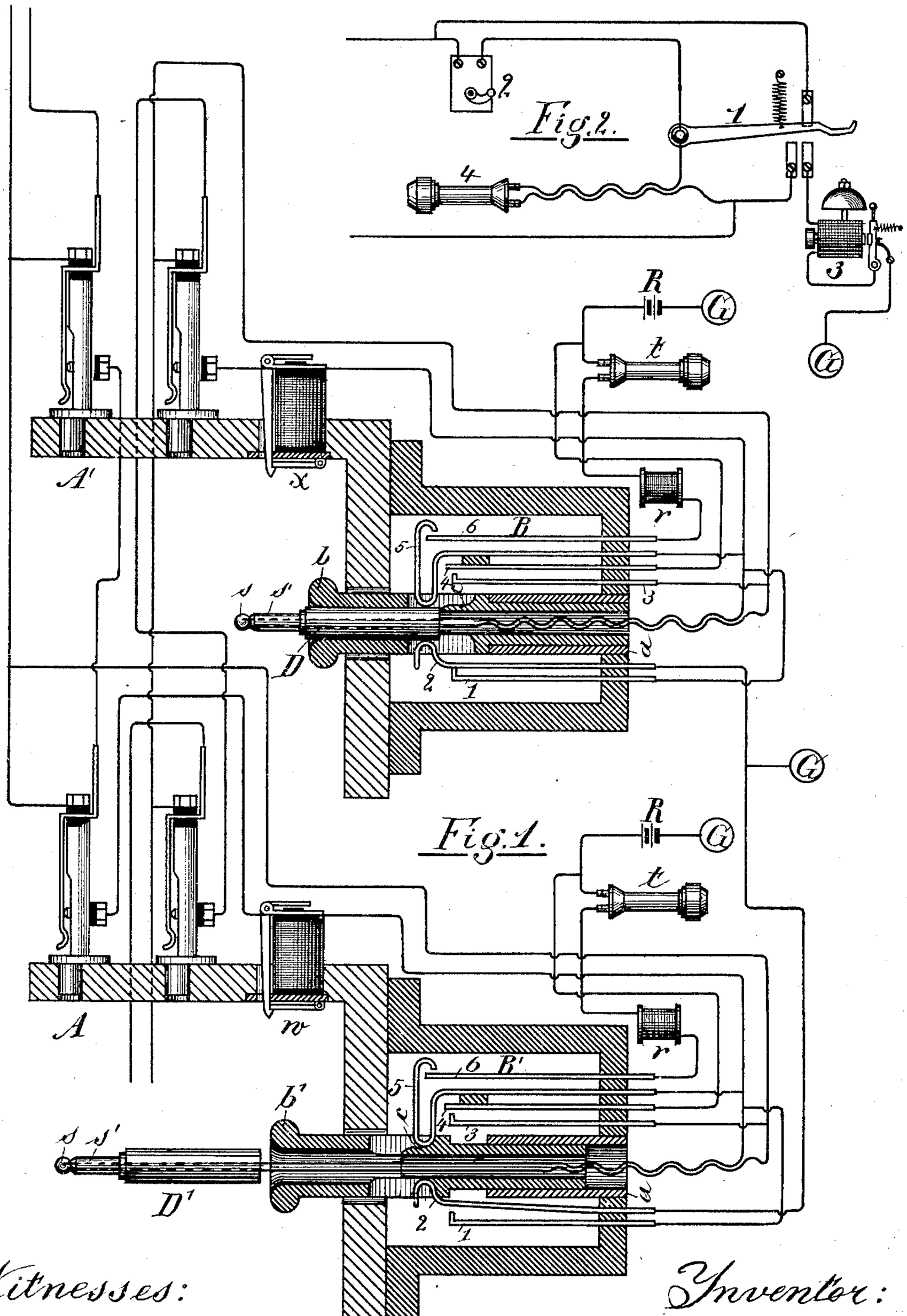
(No Model.)

# M. G. KELLOGG.

## MULTIPLE SWITCHBOARD.

No. 592,374. Patented Oct. 26, 1897.

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# UNITED STATES PATENT OFFICE.

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

## MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,374, dated October 26, 1897.

Application filed July 26, 1890. Serial No. 360,084. (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 metallic-circuit telephone-exchange system in which there is a cord and a plug attached for each line of the exchange, and when it is desired to connect the line with another line the plug is placed in the switch of the other line. Such a system is called a "single-cord" system. Said plug generally rests normally in a special switching device, and when it is desired to switch the line the plug is taken from said device.

My invention consists in a system of testing and in an organization of apparatus, circuits, and connections for each line whereby the operator may expeditiously and with few motions connect her telephone to the line when its call is indicated, may test the line wanted, may connect the two lines of two subscribers together for conversation, may connect her telephone to their circuit to determine whether they are through conversation, and may receive and attend to any clearing-out signal.

The organization which I shall describe is more simple and the operations required are less than in other systems devised to accomplish a similar purpose.

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

In the central office are as many switchboards as are found necessary or desirable in order to properly operate the exchange.

In Fig. 1, A A′ represent sectional views of sections of two switchboards. On each board of the exchange is a spring-jack or similar switch for each line. Each switch has a contact-spring which is normally in contact with a contact-point and is separated and insulated from the point when a switch-plug is inserted into the switch and has a third contact-piece which is insulated from the other parts except by the circuit connections. This contact-piece is adapted to have a test-plug applied to it. The switches shown in the figure are of well-known construction. For each line there is also a compound answering switch or device located at the board where the cord and plug of the line are located and where its calls are to be answered. This answering switch or device is operated on in part by the switch-plug when placed in its normal position and in part by the operator who answers the calls of the line. The construction, operation, and manipulation of these answering switches or devices will hereinafter be explained in detail.

Two lines and their switches on the boards, their plugs and cords, their compound answering-switches, and their annunciators are shown in Fig. 1. The answering apparatus of one line is shown as located at one board and that of the other line is shown as located at the other board.

B B′ represent the compound answering-switches of the two lines, and D D′ their switch-plugs, to which their double insulated flexible conductors are attached. These plugs are adapted to be placed in any switch at their boards and are each adapted to be placed normally, or when not in use for switching, in the answering switch of its line and to operate the switch, as will be described. One of the plugs is shown in and the other out of its switch. In said switches B B′, *a a* are cylinders, preferably of metal, adapted to receive and guide the movable commutator and plug supporting pieces *b b′*. These pieces *b b* may be of rubber and of the shape substantially as shown, or of other shapes, to correspond with variations in the construction of the other parts.

1, 2, 3, 4, 5, and 6 are contact-pieces which are insulated from each other. 2, 4, and 5 are springs. The others may be rigid. Pieces 1 and 2 are mounted parallel to each other and in close juxtaposition, so that contact between them will be made and broken by the operation of the switch-plug, as hereinafter indicated. The pairs of contacts 3 4 and 5 6 are mounted parallel to each other and in close juxtaposition, so that the contact of each pair

is made and broken, as hereinafter indicated, by the operation of the switch-plug. Spring 4 is connected near its upper end to spring 5 by means of an insulation-piece fastened to both. It therefore moves back and forth as spring 5 moves. Springs 2 and 5 are constructed and adjusted to press toward the center of piece *b* and will press against and be acted upon by the plug, as will be indicated. The piece *b* has a hole or socket in its top adapted to receive the plug-handle. It has also two chambers at its side adapted to receive the bent portions of springs 2 and 5, as shown, and has a shoulder adapted to rest on piece *a* when piece *b* is moved to its lower position. In the chamber adapted to receive the bent portion of spring 5 is a shoulder or projection, (marked *c*,) on which spring 5 bears when piece *b* is moved to its upper or outer position and which then causes the contacts between the different pieces to change, as will hereinafter be indicated. The movable pieces *b b* are adapted and intended to occupy two positions in the operation of the system—the upper or outer position, as shown in B, and the lower or inner position, as shown in B′.

When the switch-plug is in its socket in the movable piece *b*, this piece should occupy its lower position, and the handle of the plug then presses on the springs 2 and 5, so that spring 2 is brought into contact with spring 1 and spring 5 is pressed out of contact with piece 6, while spring 4, which is attached to, but insulated from, spring 5, is carried out of contact with piece 3. When the plug is withdrawn from the socket by the operator, the springs 2 and 5 are released from the pressure of the plug-handle, and (the movable piece *b* being still in its lower position) the contact between 2 and 1 is broken and that between 3 and 4 and that between 5 and 6, respectively, is established. When the plug is removed from the socket and the operator manipulates piece *b* and places it in its upper position, the contact between 1 and 2 still remains broken and the shoulder *c* in the chamber of piece *b* presses spring 5 out of contact with piece 6, and at the same time spring 5 carries spring 4 out of contact with piece 3. When, therefore, the plug is in its socket and piece *b* is in its lower position, 1 and 2 are in contact with each other, and the other contacts of the answering-switch are out of contact. When the plug is out of the socket and the piece *b* still remains in its lower position, 1 and 2 are out of contact and 3 and 4 and 5 and 6, respectively, are in contact, and when the plug is out of the socket and piece *b* is raised to its outer position all of the three pairs of contact-points are out of contact. The switch-plugs D D′ are of a usual construction of loop-switch plugs adapted to be used with the spring-jack switches. The outsides of the handles have a rubber insulation. Each plug has two contact-pieces insulated from each other, one of them, *s*, being at the end of the plug-tip and the other, *s′*, being an insulated cylinder placed along the surface of the tip. When a plug is inserted into a switch, the piece *s* presses against the spring of the switch and forces it away from the contact-point and makes connection with it, and the other piece of the plug *s′* forms connection with the third or insulated contact-piece of the switch.

*t t* are operator's telephones, R R operator's calling-batteries, and *r r* resistance-coils. Each operator has one of each of said parts, and they are connected to each other and to her answering-switches substantially as shown and as will be described.

*w* and *x* are calling-annunciators, one for each line shown.

G G are ground connections. The connections are substantially as follows: One side or branch of each line passes normally successively through the pairs of contact-points of the line-switches, passing in each case to the spring first. It then passes through the line-annunciator and is then connected through one of the insulated conductors of the switch-cord to the contact-piece *s* of the switch-plug. The other side or branch of the line is connected to all of said third contact-pieces of the switches of the line and is connected through the other conductor of the cord to the other contact-piece *s′* of the switch-plug of the line. The first-mentioned side or branch of the line is also connected, after it passes through the line-annunciator, to contact-pieces 1 and 5 of the compound answering-switch of the line, and the other side or branch of the line is connected to piece 3 of said switch, while contact-piece 2 of the switch is connected to the ground. One side of the operator's telephone is connected to contact-piece 6 and the other side of the telephone is connected to contact-spring 4 of the switch and also to the ground through the calling-battery. The resistance-coil *r* is placed in the circuit with the telephone between contact-piece 6 and contact-spring 4. Each compound answering-switch is connected to its line and to the operator's special apparatus substantially as described. These switches are distributed among the exchange-operators as their lines are assigned to the operators to attend. Weights or other suitable devices may be used to bring the switch-plugs into their normal position in their answering-switches when they are released from any connection, and they may be such also as will press or force the movable pieces to their normal lower positions.

In the subscriber's-station apparatus shown in Fig. 2, 1 is the telephone-switch. 2 is the calling-generator. 3 is the signal-receiving bell, and 4 is the subscriber's telephone. G is a ground connection. The signal-receiving bell is an ordinary circuit-breaking bell whose armature vibrates automatically while a battery-current of suitable strength passes through its magnet, making and breaking the

circuit in which it is placed and alternately striking the bell-gong. This bell is placed in a ground wire or connection to the line, which is connected to the line while the telephone is on the switch and is disconnected from the line while the telephone is off the switch. The switch has contact-points, as shown, which establishes the ground connection when the telephone is on the switch and breaks it when it is off the switch. The bell may be placed in the ground connection, as shown, or in the main circuit of the line. The circuit connections are substantially as shown, but may be changed and modified as the apparatus and their relative positions may be modified.

The operation of the system is as follows: When the plug of a line is in its normal position in the socket of the answering-switch and the line is not switched at any board and the subscriber's telephone is on its switch, the line is grounded at the subscriber's station through the automatic circuit-breaking bell. One side or branch of the line passes successively through the pairs of contact-points of its line-switch and through the pair of contact-points 1 2 of its answering-switch to ground. The calling-annunciator and the subscriber's calling-generator are in circuit between this ground connection and the normal ground connection at the subscriber's station. When the line is in this position and the operator notices a call on the line, she withdraws the plug from its normal position. When this is done, the normal circuit of the line is automatically opened at the pair of contacts 1 2 of the answering-switch and the operator's telephone is closed to the circuit of the line, the contacts being made at 3 4 and 5 6, respectively. The subscriber will in the meantime have taken his telephone down for use and by so doing removed his ground connection through the bell and switched his telephone into circuit. The operator will then find out by conversaation what line is wanted. She then places the tip *s* of the plug of the line whose call she is answering on the third contact-piece of the switch of the line wanted, and if the telephone of this line is on its switch (and the line therefore not in use) a complete test and calling circuit will exist from the ground connection at the central office through the operator's battery and telephone to that branch of the line connected with the contact-piece to which the tip of the plug is applied, through that branch to the ground-wire at the subscriber's station, and through the vibrating bell to the ground. The bell will thereby be made to ring and the subscriber notified of a call, and the make and break of the circuit by the operation of the bell will be heard by the operator in her telephone, and she will therefore know that the subscriber's telephone is not switched for use and that she may complete the connection. She will therefore place the switch-plug in the switch where she made the test, and by so doing she opens the normal circuit of the line tested and connects its two sides to the two contact-pieces of the plug and therefore to the two sides, respectively, of the line to which the plug belongs. When the apparatus is in this condition, the metallic circuit which is established between the two lines is cross-connected or bridged by a circuit connection which contains the telephone and resistance-coil. The operator will now raise the movable piece *b* of the answering-switch to its upper position, and the bridge-circuit is thereby removed and the telephone disconnected from the circuit. The same operation disconnects the operator's signal-battery from the circuit of the two lines.

The test, as indicated above, shows the operator whether or not the subscriber of the line tested has removed his telephone from its switch for conversation. The battery which causes the test indication to be made is normally disconnected from the lines, but is grounded in a circuit which contains the operator's telephone. The act of removing a line-plug from its switching device automatically connects the line to the grounded circuit which contains the operator's telephone and battery. The placing of the tip of this plug to the contact-piece of the line wanted grounds that line through the telephone and battery, and if the subscriber's telephone of that line is in its normal position on the switch his bell will be caused by the battery to ring, and the make and break of this battery-current by the operation of the subscriber's vibrating bell will cause a succession of sounds in the operator's telephone and thereby indicate to the operator that the subscriber's telephone is on its switch. It is evident that any other test indicating device than the operator's telephone which will indicate to the operator the makes and breaks of the battery-circuit when the subscriber's bell vibrates may be used as the test receiving instrument.

When the connection is made as above described, the signal-receiving bell of the subscriber to be called will ring until he removes his telephone from its switch and thereby breaks the ground connection through the bell or until the operator raises the piece *b* to its upper position and thereby disconnects the signal-battery from the circuit. The circuit through which the calling-current passes is from the ground through the battery, thence to the contacts 4 and 3, to the contact *s'* of the plug, also from the battery through the telephone and resistance-coil to contacts 6 5, to the contact *s* of the plug, and from the two contacts of the plug through the circuit of both branches of the line to the ground through the subscriber's bell. The subscriber who originated the call will generally keep his telephone off its switch until the connection is completed and conversation begins, and his bell will not ring. Should, however, he have placed his telephone on its switch, his

own bell will also be rung and he thereby notified that the other subscriber has been called. When the test and call of a line is made, of course some current from the operator's battery will pass through the complete circuit of the line to ground at the central office and therefore will pass through the annunciator of the line. The line-annunciators will, however, be of such adjustment to the circuits and the battery or of such construction and connection as to polarity that the test and calling operation will not operate the line-annunciator.

The apparatus required in this system and the operations required of an operator to complete a connection are few and simple. The operations to complete a connection after receiving a call on a line are, first, to withdraw the plug from its normal position; second, to test the line wanted with the tip of the same plug; third, to insert the plug in the switch of the line wanted, and, fourth, to raise the movable piece *b* to its upper position. To disconnect, the operator merely takes the plug from the switch and places it in its normal position and pushes the movable piece of the answering-switch to its lower position.

I use the terms "bridge" and "cross-connect" in connection with a complete metallic circuit to describe a connection between one side or branch of the circuit and its other side or branch, and an instrument in a bridge or cross-connecting circuit to a metallic circuit is not in the direct circuit, but is in a circuit connection across the two sides or branches of the circuit. I have in the specification described the telephone and resistance-coil as in a bridge or cross-connecting circuit. The annunciators are in the direct circuit.

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

1. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's circuit or system containing a telephone, a battery through which said operator's circuit or system is grounded, and contact-points and connections by which when the plug is removed from the switching device the two sides or branches of the line are automatically closed to the two sides, respectively, of said operator's circuit or system, substantially as set forth.

2. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's battery, contact-points and connections by which the battery, grounded on one side, is automatically connected on its other side to the circuit of the line when the plug is removed from the switching device, and a commutator-piece moved by the operator to disconnect the battery from such connection with the line, substantially as set forth.

3. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's circuit or system containing a telephone, a battery through which said operator's circuit or system is grounded, contact-points and connections by which when the plug is removed from the switching device the two sides or branches of the line are automatically closed to the two sides, respectively, of said operator's circuit grounded through the battery and a commutator-piece moved by the operator to break such connection between the line and the operator's circuit, substantially as set forth.

4. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and which has two pairs of contact-points, each open while the plug is in the device but automatically closed on the withdrawal of the plug, two contact-points, one of each pair, being connected to the two sides or branches of the line, the two other points being connected to the two sides of an operator's telephone, and a battery through which the circuit connecting such last points is grounded, substantially as set forth.

5. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, in the two contact-pieces of which, respectively, are connected through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and which has two pairs of contact-points, each open while the plug is in the device but automatically closed on the withdrawal of the plugs two contact-points, one of each pair, being connected to the two sides or branches, respectively, of the line, the two other points being connected to the sides, respectively, of an operator's-telephone battery through which the circuit containing such last points is grounded, and a commutator-piece moved at the will of the operator to open such pairs of contact-points automatically closed on the withdrawal of the plug, substantially as set forth.

6. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors,

the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's circuit or system containing a telephone-battery through which said operator's circuit or system is grounded, contact-points and connections by which when the plug is removed from the switching device the two sides or branches of the line are automatically closed to the two sides, respectively, of said operator's circuit or system, a vibrating bell at the subscriber's station grounded on one side, and contact-points by which the other side of the bell is connected to the circuit of the line when the subscriber's telephone is not switched for use, substantially as set forth.

7. In a telephone-exchange system, a metallic-circuit line and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's calling-battery, contact-points and connections by which the battery, grounded on one side, is connected on its other side to the circuit of the line by the act of removing the plug from the device, a bell at the subscriber's station and contact-points and connections by which the circuit of the line is grounded through said bell when the subscriber's telephone is not switched for use, substantially as set forth.

8. In a telephone-exchange system, a metallic-circuit line grounded at the subscriber's station through a bell when the telephone is not switched for use and not otherwise, and a loop-switch plug, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device in which the plug is normally placed and on which it operates, an operator's battery, contact-points and connections by which the battery, grounded on one side, is automatically connected on its other side to the circuit of the line by the act of removing the plug from the switching device, and a commutator-piece moved by the operator to disconnect the battery from such connection with the line, substantially as set forth.

9. In a telephone-exchange system, a metallic-circuit line grounded at the subscriber's station while his telephone is not switched for use and a switch-plug for the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's calling-battery, contact-points and connections by which the battery grounded on one side is automatically connected to the circuit of the line by the act of removing the plug from the device, and a signal-bell at the subscriber's station in the normal circuit between such subscriber's-station and central-office grounds, substantially as set forth.

10. In a telephone-exchange system, a metallic-circuit line grounded at the subscriber's station while his telephone is not switched for use but not otherwise and a switch-plug for the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's battery and her telephone, contact-points and connections by which the circuit which contains the battery and telephone grounded on one side is connected to the circuit of the line by the act of withdrawing the plug from the device, and a vibrating bell at the subscriber's station normally in the circuit between said subscriber's-station and central-office grounds, substantially as set forth.

11. In a telephone-exchange system, a metallic-circuit line grounded at the subscriber's station while his telephone is not switched for use but not otherwise, and a vibrating bell in such ground connection in combination with a circuit at the central office which is grounded at one end, a test receiving instrument and battery in said circuit and a switching device whereby the operator may at will connect the other end of such circuit with the circuit of the line, said battery being of such strength as to operate said bell and said test receiving instrument being such as to indicate the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

12. In a telephone-exchange system, a metallic-circuit line grounded at the subscriber's station while his telephone is not switched for use but not otherwise, in combination with a circuit at the central office which is grounded at one end, a test receiving instrument and battery in said circuit, switching devices whereby the operator may at will connect the other end of such circuit with the line, and a vibrating bell at the subscriber's station in the circuit between such subscriber's-station and central-office grounds, said battery being of such strength as to operate said bell and said test receiving instrument being such as to indicate the make and break of the battery-current, caused by the operation of said bell, substantially as set forth.

13. In a telephone-exchange system, metallic-circuit lines and loop-switch plugs, one for each line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device for each plug, into which the plug is normally placed and on which it operates, an operator's circuit or system containing a telephone, a battery through which said operator's circuit or system is grounded, and contact-points and connections by which, when the plug is removed from the switching device, the two sides or branches of the line are automatically closed to the two sides, respectively, of said operator's circuit or system, substantially as set forth.

14. In a telephone-exchange system, metal-

lic-circuit lines and loop-switch plugs, one for each line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device for each plug into which the plug is normally placed, and on which it operates, an operator's battery, contact-points and connections by which the battery, grounded on one side, is automatically connected on its other side to the circuit of the line by the act of removing the plug from the switching device, and a commutator-piece adapted to be moved by the operator to disconnect the battery from such connection with the line, substantially as set forth.

15. In a telephone-exchange system, metallic-circuit lines and loop-switch plugs, one for each line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device for each plug into which the plug is normally placed and on which it operates, an operator's circuit or system containing a telephone, a battery through which said operator's circuit or system is grounded, contact-points and connections by which, by the removal of the plug from the switching device, the two sides or branches of the line are automatically closed to the two sides, respectively, of the operator's circuit, and a commutator-piece adapted to be moved by the operator to break such connection between the line and the operator's circuit, substantially as set forth.

16. In a telephone-exchange system, metallic-circuit lines and loop-switch plugs, one for each line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device for each plug, into which the plug is normally placed, and which has two pairs of contact-points, each open while the plug is in the device, but automatically closed by the withdrawal of the plug, two contact-points, one of each pair, being connected to the two sides or branches of the line, the two other points being connected to the two sides of an operator's telephone, and a battery through which the circuit connecting such last points is grounded, substantially as set forth.

17. In a telephone-exchange system, a metallic-circuit line which is grounded at the subscriber's station when the subscriber's telephone is not switched for use, and a loop-switch plug for the line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's battery, contact-points and connections by which the battery, grounded on one side, is automatically connected on its other side to the circuit of the line by the removal of the plug from the switching device, a commutator-piece moved by the operator to disconnect the battery from such connection with the line, and a vibrating bell at the subscriber's station in circuit between such ground connections at the subscriber's station and the central office, substantially as set forth.

18. In a telephone-exchange system, a metallic-circuit line, and a switch at the subscriber's station with contact-points by which the line is grounded when his telephone is switched for use but not otherwise, in combination with a circuit connection at the central office, a battery and test receiving instrument in said circuit connection, said circuit connection being grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with the line, and a vibrating bell at the subscriber's station in the circuit which may thereby be established from the central-office ground to the subscriber's ground, said battery having sufficient strength to operate said bell and the test receiving instrument being such as to respond to the vibrations of the bell when the battery, bell and instrument are thus placed on closed circuit, whereby, by one motion, the operator tests the line and also calls the subscriber whose telephone is not switched for use, substantially as set forth.

19. In a telephone-exchange system, metallic-circuit lines and loop-switch plugs, one for each line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device for each plug into which the plug is normally placed and on which it operates, an operator's circuit or system containing a telephone and grounded through a battery, contact-points and connections by which, when the plug is removed from the switching device, the two sides or branches of the line are automatically closed to the two sides, respectively, of the operator's circuit, a signal instrument at each subscriber's station through which the line-circuit is normally grounded, adapted to respond when placed on closed circuit with said battery, and a commutator-piece adapted to be moved by the operator to break such connection between the line and the operator's circuit, substantially as set forth.

20. In a telephone-exchange system, a metallic-circuit line which is grounded at the subscriber's station when the subscriber's telephone is not switched for use, and a loop-switch plug for the line, to the two contact-pieces of which, respectively, are connected, through flexible conductors, the two sides or branches of the line, in combination with a switching device into which the plug is normally placed and on which it operates, an operator's battery, contact-points and connections by which the battery, grounded on

one side, is automatically connected on its other side to the circuit of the line when the plug is removed from the switching device, a signal instrument at the subscriber's station through which the line-circuit is normally grounded adapted to respond when placed on closed circuit with said battery, a commutator-piece adapted to be moved by the operator to disconnect the battery from such connection with the line, and a vibrating bell at the subscriber's station in circuit between such ground connections at the subscriber's station and the central office, substantially as set forth.

In witness whereof I hereunto subscribe my name this 23d day of June, 1890.

MILO G. KELLOGG.

Witnesses:

EMIL ABENHEIM,

C. STRICH-CHAPELL.