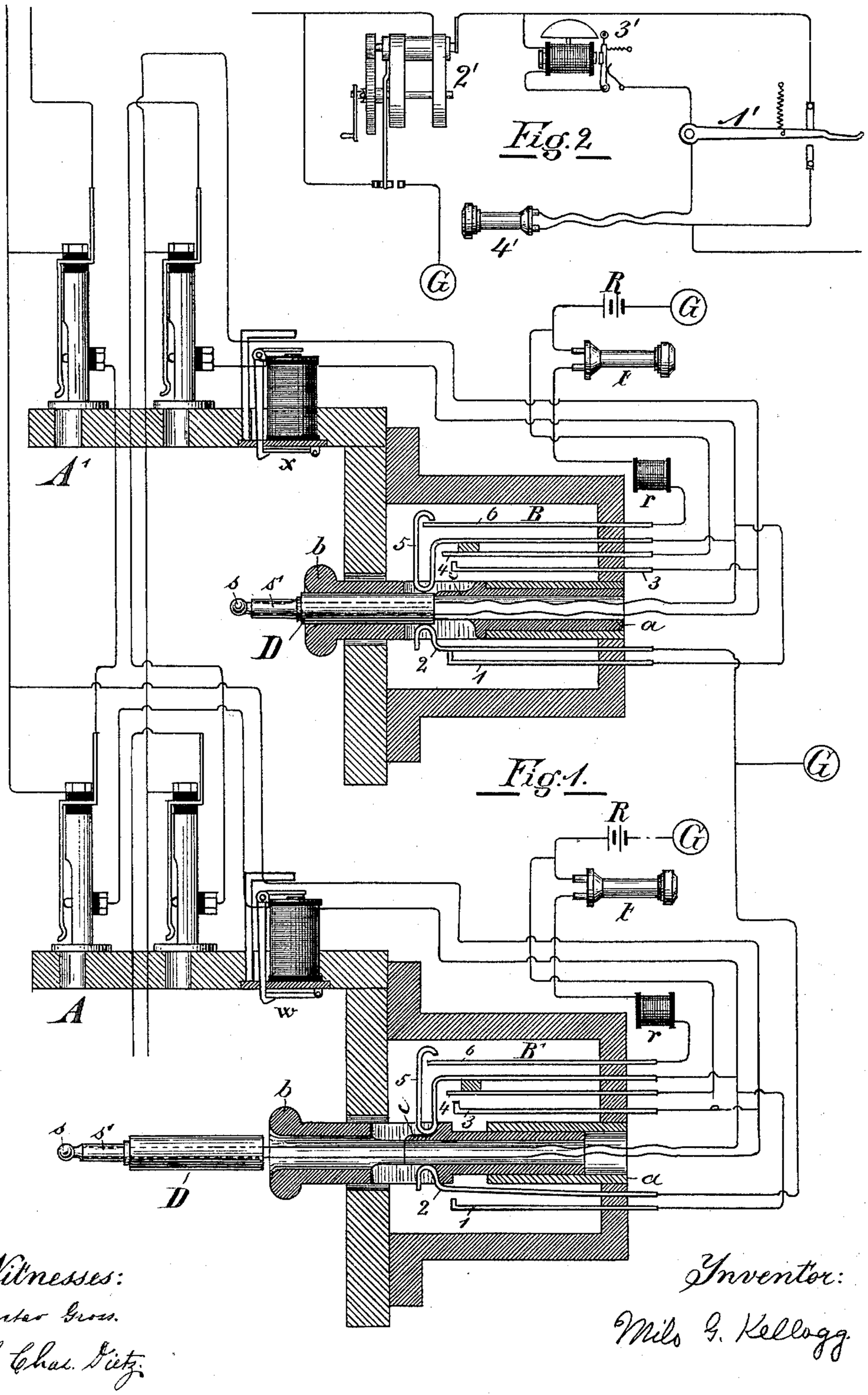
(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,377. 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. 592,377, dated October 26, 1897.

Application filed July 26, 1890. Serial No. 360,088. (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 metallic-circuit telephone-exchange system in which there is a cord and a plug attached to the cord for each line to which the line is connected. Said plug is inserted into the switch of another line when it is desired to switch the two lines together for conversation. Said system is called a "single-cord" system. The plug generally rests normally (or when not in use for switching) in its own special switching device.

My invention consists in a system of testing, and in apparatus, circuit, and connections for each line, whereby the operator may expeditiously and with few movements connect her telephone to the circuit of the line when its call is indicated, may test the line wanted and at the same time ring the subscriber's signal-bell when the line is not in use, may connect the two lines together, may connect her telephone to their circuit to determine whether they are through conversation, and may disconnect the lines and place the apparatus in readiness to receive a new call. Said system and apparatus are more simple and the work required is less than in other systems devised for a similar purpose.

In the accompanying drawings, illustrating my invention, Figure 1 is a diagram illustrating two switchboards and the main-line central-office apparatus of two lines, and Fig. 2 shows in diagram a subscriber's apparatus for his office or station.

In Fig. 1, A A′ represent sections of two multiple switchboards at the central office of the exchange. On each board is a spring-jack switch for each line. Each switch has a contact-spring which is normally in contact with a contact-point, but is separated and insulated from the point when a switch-plug is inserted into the switch, and has a third or insulated contact-piece which is insulated from the other parts except by the circuit connections. This contact-piece is adapted to have a plug applied to it for calling and testing. The switch shown in the drawings is of well-known construction.

For each line there is a compound answering switching device located at the board where the cord and plug of the line are located and where its calls are to be answered. This device is manipulated in part by the switch-plug when in the device and in part by the operator who answers the call. The construction, operation, and manipulation of these devices will hereinafter be explained in detail.

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

B B′ represent the two compound answering-switches, and D D the two switch-plugs of the lines, to which their double flexible conducting-cords are attached, and which are adapted to be placed in any spring-jack switch at the board where they are located. One plug is shown in its switching device and one plug is shown out of its device ready to be inserted into the switch of any line.

In the compound answering-switches, *a a* are cylinders, preferably of metal, adapted to receive and guide the movable commutator and plug supporting pieces *b*. This piece may be of rubber, and is of the shape substantially as shown, and may be other shapes to correspond with variations which may be made in the construction, shape, and arrangement of the other parts.

1, 2, 3, 4, 5, and 6, are contact-pieces insulated from each other, as shown. 2, 4, and 5 are elastic pieces. The others may be rigid. The piece *b* has a hole or socket in which the handle of the plug may be placed. It has also two chambers to receive the bent portions of springs 2 and 5, as shown, and has a shoulder which rests on the top of cylinder *a* when piece *b* is moved to its lower position. In the chamber adapted to receive spring 5 is a shoulder or projection *c*, on which 5 presses

when piece *b* is moved to its higher or outer position and which causes the contacts of the contact-pieces to change, as will be indicated. 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 will be 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 by the operation of the switch-plug, as will be indicated. Spring 4 is connected near its upper end to spring 5 by means of an insulating-piece fastened to both. It is therefore moved 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 operated upon by the plug, as will be indicated. The pieces *b b* are adapted to occupy two positions, the upper one shown in B′ and the lower one in B. When the plug is in its socket in *b*, the piece *b* occupies its lower position and the handle of the plug presses on springs 2 and 5, so that 2 is in contact with 1 and 5 is out of contact with 6, while 4 is kept by 5 out of contact with piece 3. When the switch-plug is withdrawn by the operator from the socket, the springs 2 and 5 will be released from the pressure of the plug-handle and (the movable piece being still in its inner position) contact between 2 and 1 is broken and that between 5 and 6 and between 3 and 4 is established. When the plug is removed and the operator manipulates piece *b* and places it in its outer position, the contact between pieces 1 and 2 still remains broken and shoulder *c*, in the chamber of the piece, presses spring 5 out of contact with piece 6, and spring 4 is carried out of contact with piece 3. When, therefore, the plug is in the socket and the piece *b* is in its lower position, 1 and 2 are in contact with each other and the other contacts of the device are out of contact. When the plug is out of the socket and piece *b* is still in its lower position, 1 and 2 are out of contact and 3 4 and 5 6 are in contact, respectively, and when the plug is out of the socket and the piece *b* is raised to its outer position, all three pairs 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 shown. The outsides of the handles have a rubber insulation. Each plug has two contact-pieces insulated from each other, one, *s*, at the end of the plug and the other, *s′*, along the plug-cylinder tip. When a plug is inserted into any of the switches, the piece *s* presses against the spring of the switch and forces the spring away from the contact-point and forms connection with the spring, and the other piece, *s′*, of the plug forms connection with the metal frame or socket of the switch.

t t are operators' telephones, R R calling-batteries, and *r r* resistance-coils. Each operator has one of each of 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, and connected into their respective circuits, as will hereinafter be described. They are preferably polarized annunciators.

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 by one of the insulated conductors of the switch-cord to contact-piece *s* of the plug. It is also connected to contact-pieces 5 and 1 of the answering-switch of the line. The other branch of the line is connected to said third or insulated contact-pieces of its switches. It is also connected through the other conductor of the cord to contact-piece *s′* of the plug, and is connected to contact-piece 3 of the answering-switch. Contact-piece 2 of this switch is connected to the ground. One side of the operator's telephone is connected to contact-piece 4 of the answering-switch and also to the ground through her calling-battery. The other side of the telephone is connected through the resistance-coil *r* to piece 6 of the switch.

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. The bell is an ordinary vibrating or automatic circuit-breaking bell, which continually makes and breaks its own circuit and rings while a battery of suitable strength is closed through its circuit. The contact points and connections are substantially as shown, but may be of other forms and arrangements which shall perform practically the operation required. They should be such that the signal-receiving bell or its contact-points are switched or shunted out of the circuit of the line while the subscriber's telephone is off the switch for use, while they are in the line-circuit while the telephone is on the switch or not switched for use.

The operation of the system is as follows: When the plug of a line is in its normal position in the socket of its answering-switch and the line is not switched at any board, that branch of the line which passes through the several pairs of contact-points is grounded at the central office. When the plug is withdrawn from its normal position, or a plug is placed in one of its switches, this ground connection is removed. When the plug of a line is withdrawn from its normal position in the answering-switch, the two sides or branches of the line are brought into a closed circuit with the operator's telephone in the circuit. The connection is automatically made by the closing of the two pairs of

contact-points 3 4 and 5 6. The points 3 and 5 are connected to the two sides of the line and 4 and 6 are connected to the two sides of the telephone. The operator then by conversation finds out what line is wanted. She then places the tip *s* of the plug of the calling-line on the third or insulated contact-piece of the line wanted, and if the line is not switched at any board (and its normal ground connection broken) and the subscriber's telephone is not switched for use a complete circuit is established, which contains the operator's calling-battery and telephone and the subscriber's circuit-breaking bell, and the bell will ring, calling the subscriber. This complete circuit is from the ground through the operator's calling-battery and telephone-contacts 5 6 of the switching device of the plug used and the contact-piece *s* of the plug, thence through the circuit of the line and the subscriber's bell when in the circuit, the normally closed contacts of the line-switches, and contacts 1 2 of the plug-switching device of the line to the ground. The operator also will distinguish in her telephone the make and break of a bell and will know that the line is "free" to be connected to. She will then push the plug into the switch and by so doing disconnect the line from its normal ground connection. The test-circuit (from the operator's ground through her apparatus to the circuit of the line and through the line to its normal ground connection) will be broken and the bell will stop ringing. The two lines are thereby connected into a metallic circuit which is cross-connected or bridged by a circuit which contains the operator's telephone and resistance-coil, and the subscriber wanted has been called. The operator then raises the movable piece *b* of the answering-switch and by so doing breaks the connections at 3 4 and 5 6 and removes the bridge connection. Should she wish at any time to listen into the circuit to determine whether the subscribers are through conversation, she will again establish the bridge connection by pressing in the piece *b* and a part of any telephone-current passing over the circuit will be deflected through her telephone. The use of the resistance-coil is to prevent an undue amount of the current from passing through the telephone. It will be observed that the subscriber's bell will ring just so long as the operator holds the tip of the plug on his switch, and when the plug is pushed into the switch the bell stops ringing. It will also be seen that had the line been switched at any board by the use of its plug or through one of its switches, or had the subscriber's telephone been switched for use and the bell thereby switched from the circuit, the bell would not have rung and the operator would not have got the signal which indicates that the line is clear. She would not, therefore, have switched the line with the line which desired the connection. A subscriber's line, therefore, tests "busy" and is reserved to himself, whether it is switched at any board or his telephone is switched for use, and the service is more satisfactory than it would be were the test "busy" made by only one of these operations. Had the subscriber taken down his telephone for use when the test was made, but the line had not been switched at the central office, the operator would hear a single "click" in her telephone, but not a succession of sounds. She would then know that the subscriber's telephone was switched for use, but that the line was not yet switched.

The operations to answer a call and complete a connection are these: First, to remove the plug from its normal position; second, to put the plug on the switch-contact of the line wanted and then push it into the switch, and, third, to raise or move up the piece *b* of the answering-switch. In order to listen to the circuit of two lines connected together, the operator merely pushes down on the piece *b* of the answering-switch and her telephone is connected in a bridge to their circuit.

The calling-batteries R R should be strong enough to operate the vibrating bell of any line when a battery and bell are closed to each other, as heretofore indicated. The number of cells required will depend on the resistance of the circuit (including line test receiving instrument, calling-annunciator, and bell) and also on the character of the bell and the number of convolutions of its electromagnet. As a general thing as many as twenty-five or thirty, or even more, cells will be required for this purpose.

The operator's telephone is used for the test receiving instrument. Other forms of test receiving instrument may be used, but they should be such that when closed, as described, to the vibrating bell and the battery the instrument will respond to the vibrations of the bell.

The calling-annunciators should be connected into their respective circuits and the operator's calling-batteries should be connected in the circuits in such a direction that the calling and testing current directed to any line will not operate the annunciator and give a false signal to its operator that the subscriber has sent in a call. The line-annunciators are distributed among the various boards of the exchange, and as the battery is a strong one an annunciator at a distant board might be made to indicate a call when a test is made were it not for this arrangement of the polarized annunciators and batteries; but by this construction and connection of the annunciators and the batteries the false signals that the lines are wanted are prevented and confusion avoided. With electric batteries for signaling and testing and with ordinary polarized annunciators for receiving calls such connection is simple and easily understood by those skilled in the art.

The calling-generator shown in Fig. 2 has an automatic device with contact-points and con-

nections by which the line-circuit is automatically grounded while the generator is operated with the generator in the line-circuit between such ground connection and the normal ground connection of the line at the central office.

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.

The subject-matter claimed herein is analogous to what is claimed in my application, Serial No. 360,089, except in this case (Serial No. 360,088) the claims recite a vibrating bell. The system of testing and calling is also shown in my application, Serial No. 361,114; but in the latter case the test and call battery is in the normal ground connection 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, a metallic-circuit telephone-line one side or branch of which is normally connected with the ground at the central office but disconnected from such ground while switched for conversation and the other side or branch of which is normally open at the central office, in combination with a vibrating bell at the subscriber's station normally in the circuit of the line but switched or shunted from said circuit while the subscriber's telephone is switched for use, and a test wire or circuit at the central office containing a test receiving instrument and battery, grounded at one end and connected at its other end to a plug or device adapted to be brought into connection with the normally open end of the line, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

2. In a telephone-exchange system, a metallic-circuit telephone-line one side or branch of which is normally connected with the ground at the central office but disconnected from such ground while switched for conversation and the other side or branch of which is normally open at the central office, in combination with a vibrating bell at the subscriber's station normally in the circuit of such line but switched or shunted from such circuit while the subscriber's telephone is switched for use, a test receiving instrument at the central office grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with the normally open end of the line, and a battery in the test-circuit established on testing, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

3. In a telephone-exchange system, a metallic-circuit line, one side or branch of which is normally connected with the ground at the central office and the other side or branch of which is normally open at the central office, in combination with switching apparatus by which the line is disconnected from such ground connection while it is switched for conversation, a vibrating bell at the subscriber's station, normally in the circuit of the line, a switch with contacts and connections by which the bell is shunted while the subscriber's telephone is switched for use and a test wire or circuit at the central office, containing a test receiving instrument and battery, grounded at one end and connected at its other end to a plug or device adapted to be brought into connection with such normally open end of the line, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

4. In a telephone-exchange system, a metallic-circuit line one side or branch of which is normally connected with the ground at the central office and the other side or branch of which is normally open at the central office, in combination with switching apparatus by which the line is disconnected from such ground connection while switched for conversation, a vibrating bell at the subscriber's station, normally in the circuit of the line, a switch with contacts and connections by which the bell is shunted while the subscriber's telephone is switched for use, a test receiving instrument at the central office grounded on one side and connected on its other side to a test plug or device adapted to be brought into connection with the normally open end of the line, and a battery in the circuit established on testing, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

5. In a telephone-exchange system, a metallic-circuit line, one side or branch of which contains a polarized annunciator and is normally grounded at the central office but disconnected from the ground while switched for conversation and the other side or branch of which is normally open at the central office, in combination with a vibrating bell at the subscriber's station normally in the circuit of the line but switched or shunted while the subscriber's telephone is switched for use, and a test wire or circuit at the central office containing a test receiving instrument and battery, grounded at one end and connected at the other end to a plug or device adapted

to be brought into connection with the normally open end of the line, the annunciator and battery being so connected into the circuit that the battery does not operate the annunciator, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

6. In a telephone-exchange system, a metallic-circuit line, one side or branch of which contains a polarized annunciator and is normally grounded at the central office and the other side or branch of which is normally open at the central office, in combination with switch apparatus by which the line is disconnected from such ground connection while switched for conversation, a vibrating bell at the subscriber's station, normally in the circuit of the line, a switch with contacts and connections by which the bell is switched or shunted from the line while the subscriber's telephone is switched for use, 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 said normally open end of the line, and a battery in the circuit thereby established, the annunciator and battery being so connected into the circuit that the battery does not operate the annunciator, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

7. In a telephone-exchange system, a metallic-circuit line, one side or branch of which contains an annunciator and is normally grounded at the central office but disconnected from the ground while switched for conversation and the other side or branch of which is normally open at the central office, in combination with a vibrating bell at the subscriber's station, a switch with contacts and connections by which the bell is switched or shunted from the circuit while the subscriber's telephone is switched for use, and a test wire or circuit at the central office, containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought into connection with the normally open end of the line, said annunciator and battery being so constructed and connected that when thus connected in a circuit the battery does not operate the annunciator, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

8. In a telephone-exchange system, a metallic-circuit line one side or branch of which contains an annunciator and is normally grounded at the central office and the other side or branch of which is normally open at the central office, in combination with switch apparatus by which the line is disconnected from such ground connection while switched for conversation, a vibrating bell at the subscriber's station normally in the circuit of the line but switched or shunted from such circuit while the subscriber's telephone is switched for conversation, a test receiving instrument at the central office grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with the normally open end of the line, and a battery in the circuit thereby established, said annunciator and battery being so constructed and connected that when thus connected into a circuit the battery does not operate the annunciator, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

9. In a telephone-exchange system, a metallic-circuit line normally disconnected from the ground at the subscriber's station, one side or branch of which is normally connected with the ground at the central office but disconnected from such ground connection while switched for conversation, in combination with a vibrating bell at the subscriber's station, normally in the circuit of the line but switched or shunted from the circuit while the subscriber's telephone is switched for use, and a test wire or circuit at the central office, containing a test receiving instrument and a battery, grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with the normally open end of the line, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

10. In a telephone-exchange system, a metallic-circuit line normally disconnected from the ground at the subscriber's station, one side or branch of which is normally connected with the ground at the central office and the other side or branch of which is normally open at the central office, in combination with switching apparatus by which such ground connection at the central office is broken while the line is switched for conversation, a vibrating bell at the subscriber's station normally in the circuit of the line, a switch with contacts and connections by which the bell is switched or shunted while the subscriber's telephone is switched for use, a test receiving instrument at the central office grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with the normally open end of the line, and a battery in the circuit thereby established, said battery

being so strong as to operate said bell and said test receiving instrument being such as to respond to the make and break of the battery-current caused by the operation of said bell, substantially as set forth.

11. In a telephone-exchange system, a metallic-circuit line normally disconnected from the ground at the subscriber's office, one side or branch of which contains a polarized annunciator and is normally grounded at the central office but disconnected from the ground while the line is switched for conversation and the other side or branch of which is normally open at the central office, in combination with a calling-generator at the subscriber's station, contact-points and connections by which the line is grounded while the generator is operated with the generator in circuit between such ground connection and the normal ground at the central office, a vibrating bell normally in the circuit of the line at the subscriber's station but switched or shunted from circuit while the subscriber's telephone is switched for use and a test wire or circuit containing a test receiving instrument and a battery, grounded at one end and connected at its other end to a plug or device adapted to be brought into connection with the normally open end of the line, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to 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 normally disconnected from the ground at the subscriber's station, one side or branch of which contains a line-annunciator and is normally grounded at the central office and the other side or branch of which is normally open at the central office, in combination with switching apparatus to disconnect the line from its normal connection with the ground while it is switched for use, a calling-generator at the subscriber's station, contact-points and connections by which the line is grounded while the generator is operated with the generator between such ground connection and the normal ground connection of the line at the central office, a vibrating bell at the subscriber's station normally in the circuit of the line, a switch with contacts and connections by which the bell is switched or shunted from the circuit while the subscriber's telephone is switched for use, a test receiving instrument at the central office, grounded on one side and connected on its other side to a plug or device adapted to be brought into connection with the normally open end of the line, and a battery in the circuit thereby established, said battery being so strong as to operate said bell and said test receiving instrument being such as to respond to 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, a metallic-circuit line one side or branch of which is normally grounded at the central office and the other side or branch of which is normally open at the central office, in combination with switching apparatus by which such normal ground connection is broken while the line is switched for conversation, a vibrating bell normally in the circuit of the line at the subscriber's station, a switch with contact-points and connections by which the bell is switched or shunted from the circuit while the subscriber's telephone is switched for conversation, connecting apparatus by which the operator may temporarily ground such normally open side or branch of the line, and a battery in the circuit which may thereby be established, said battery being so strong as to operate said bell, and the test receiving instrument being such as to respond to the vibrations of the bell when they are thus included in closed circuit with each other, substantially as set forth.

14. In a telephone-exchange system, a metallic-circuit line which is normally disconnected from the ground at the subscriber's station and has a vibrating bell there in its circuit while his telephone is not switched for use and only then, one side or branch of the line being normally grounded at the central office and the other side or branch of the line being normally open at the central office, in combination with apparatus by which the operator may ground such normally open side or branch of the line and a battery in the circuit thereby established, said battery being so strong as to operate said bell when they are thus included in closed circuit with each other, substantially as set forth.

15. In a telephone-exchange system, a metallic-circuit line which is normally disconnected from the ground at the subscriber's station and has there a vibrating bell in its circuit while his telephone is not switched for use, one side or branch of the line being normally grounded at the central office and the other side or branch being normally open at the central office, in combination with switch apparatus by which such normal ground connection is broken while the line is switched for conversation, connecting apparatus by which the operator may temporarily ground such normally open side or branch of the line, and a battery in the circuit thereby established, said battery being so strong as to operate said bell when they are thus included in closed circuit with each other, 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.