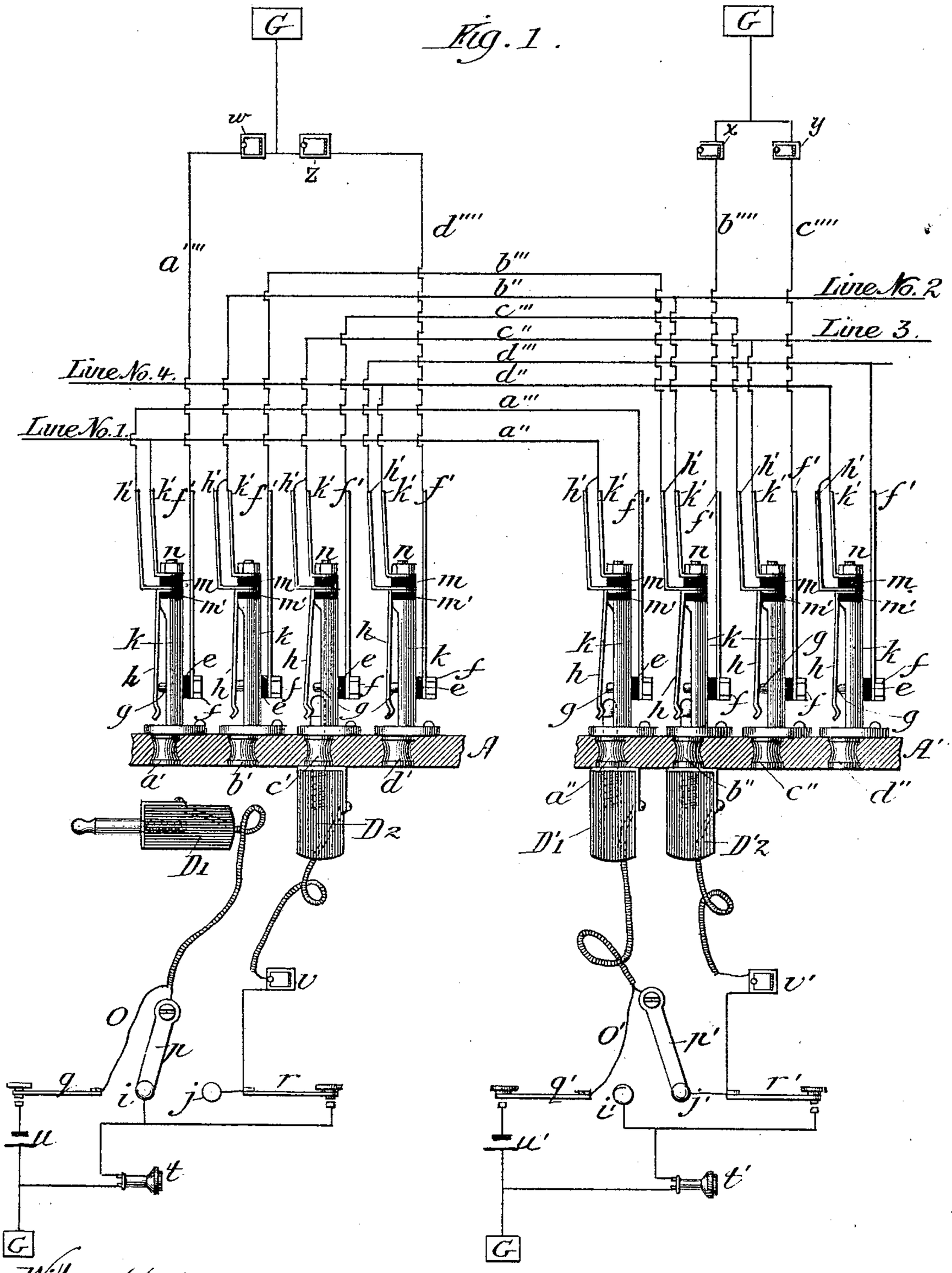
(No Model.) 3 Sheets—Sheet 1.

M. G. KELLOGG.

MULTIPLE SWITCH BOARD.

No. 388,283. Patented Aug. 21, 1888.

Fig. 1.



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(No Model.) 3 Sheets—Sheet 2.

M. G. KELLOGG.

MULTIPLE SWITCH BOARD.

No. 388,283. Patented Aug. 21, 1888.

Fig. 1d.

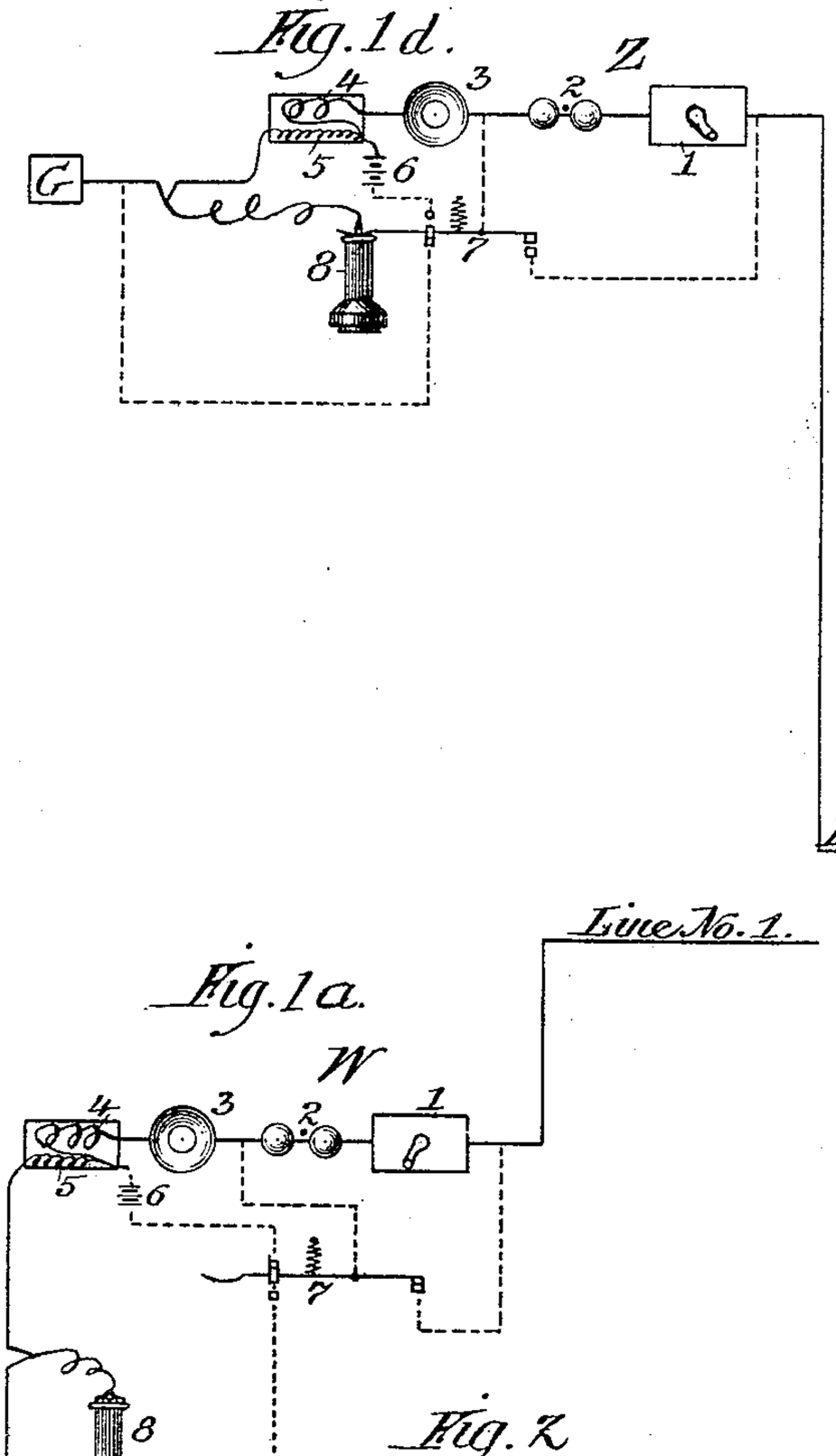
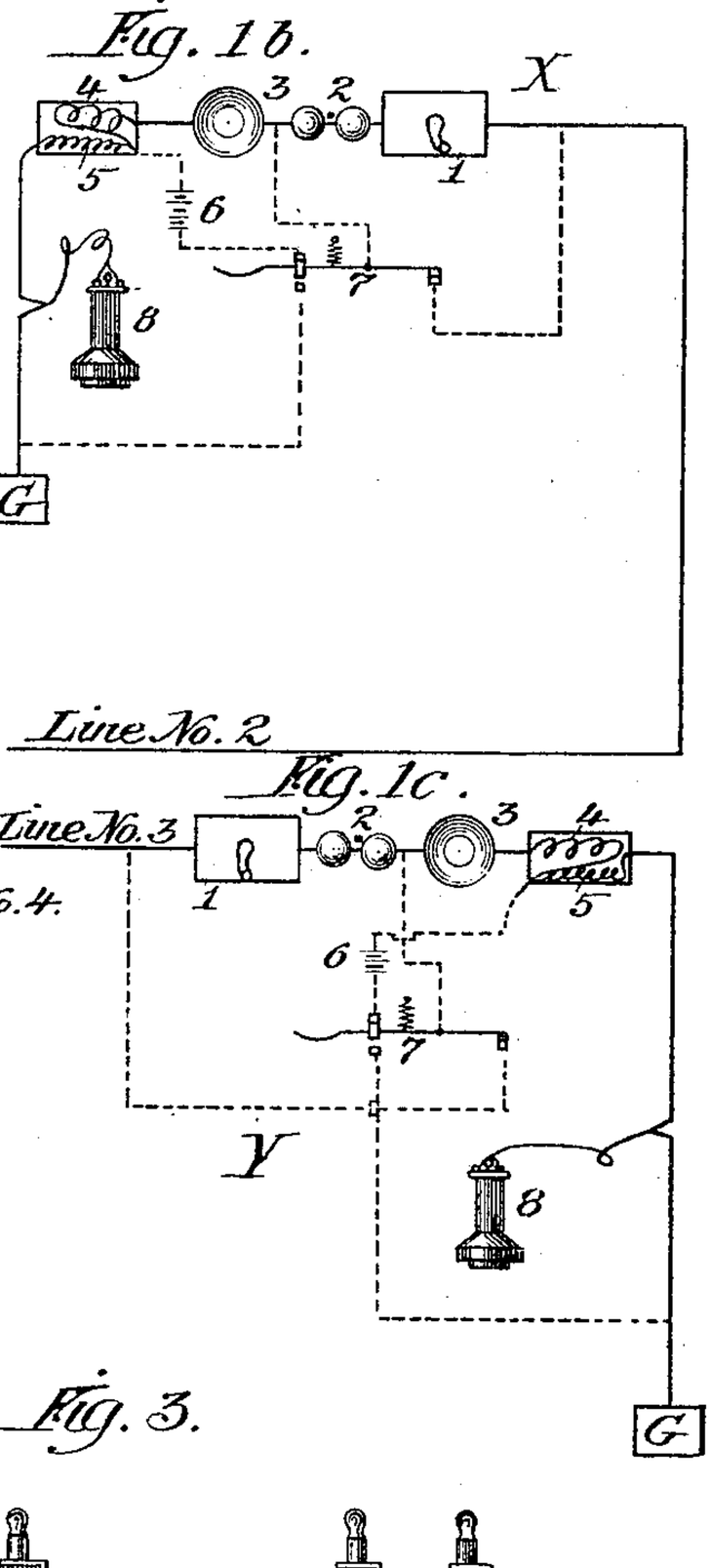


Fig. 1b.



Line No. 2

Fig. 1c.

Line No. 1.

Fig. 1a.

Fig. 2.

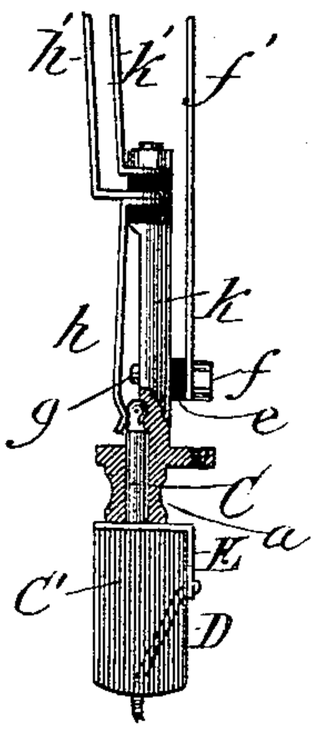
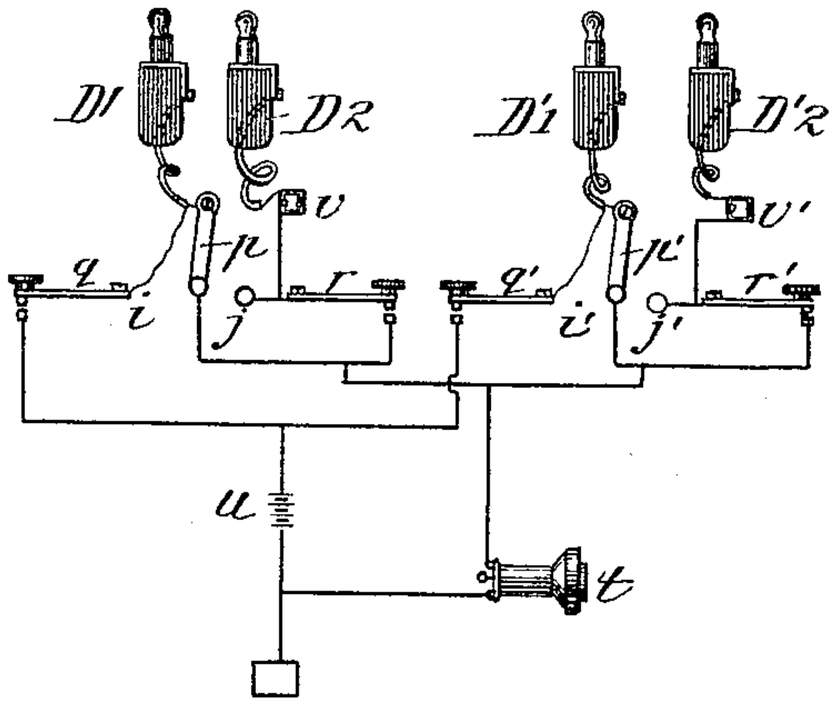


Fig. 3.



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3 Sheets—Sheet 3.

M. G. KELLOGG.

MULTIPLE SWITCH BOARD.

No. 388,283. Patented Aug. 21, 1888.

Fig. 1e

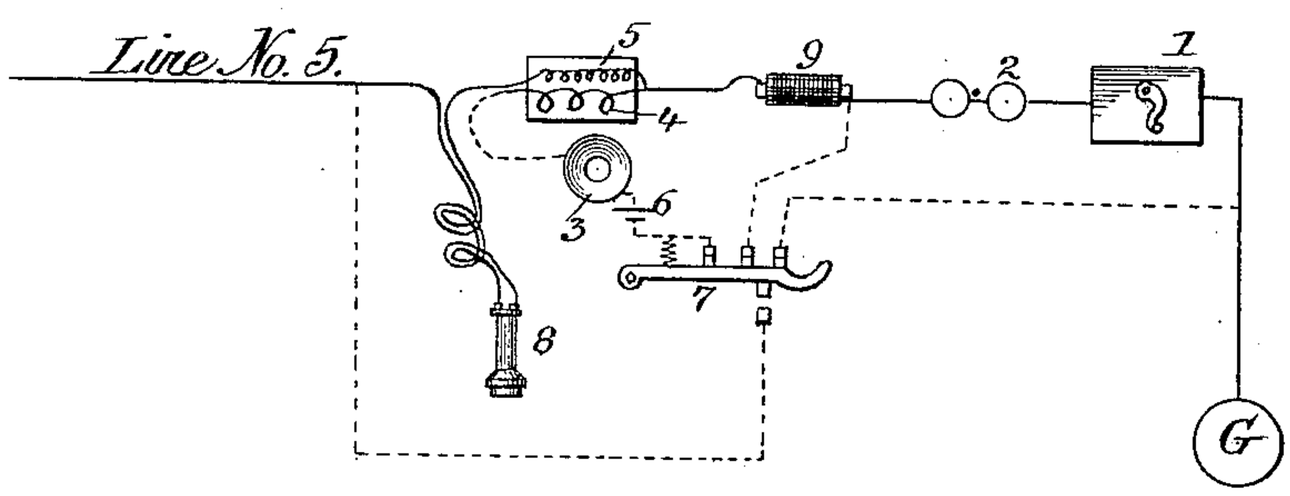


Fig. 1f.

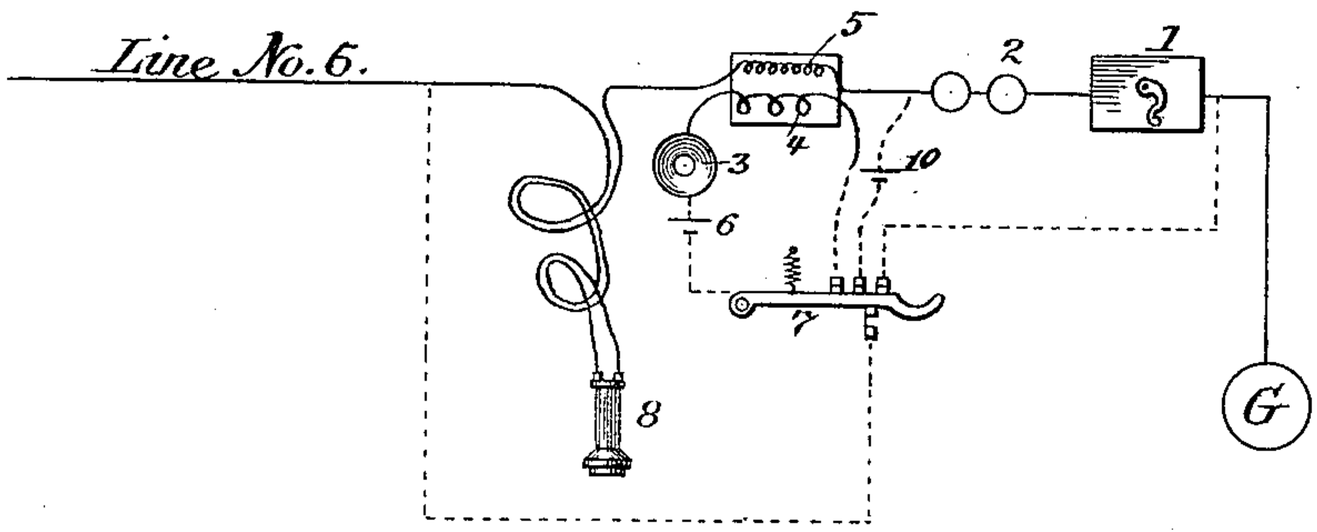
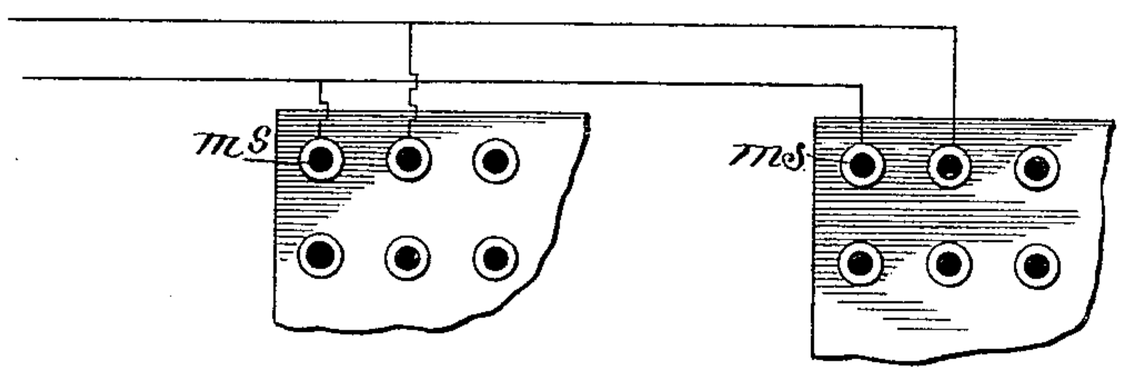


Fig. 4.



Witnesses:
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UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF HYDE PARK, ILLINOIS.

MULTIPLE SWITCH-BOARD.

SPECIFICATION forming part of Letters Patent No. 388,283, dated August 21, 1888.

Application filed March 14, 1887. Serial No. 230,805. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Hyde Park, Illinois, have discovered certain new and useful Improvements in Multiple Switch-Boards for Telephone-Exchanges, of which the following is such a full, clear, concise, and exact description as will enable those skilled in the art of telephony to practice my invention, reference being had to the accompanying drawings, forming a part of this specification.

My invention is designed to facilitate the work of switching at the central office of a telephone-exchange district system.

It consists, first, of a multiple switch-board system, which I shall hereinafter describe and claim in detail; and it consists, secondly, of a certain central-office system of cords with plugs, keys, switches, telephone, battery, and circuits for answering, testing, calling, and clearing out subscribers' lines, which I shall hereinafter describe and claim in detail, said system being applicable to said multiple switch-board system mentioned above, and to other systems of telephone-exchange switch-boards.

In my multiple switch-board system I place as many switch-boards in the central office as are found necessary or desirable in order to properly answer the calls and connect and disconnect the subscribers' lines. On each board I place, for each telephone-line which centers at the office, a spring-jack or similar switch having two insulated contact-points and adapted to receive a plug, and when the plug is inserted to disconnect the contact-points and connect one of them with the flexible conducting-cord attached to the plug, and when the plug is withdrawn to again connect the contact-points. On each board I also place, for each of said telephone-lines, a metallic test-bolt or contact-piece insulated from the other parts of the apparatus, except as by conducting-wires, as shown and described.

For convenience I have used the metallic test-bolt or contact-piece of a line as a frame-work to support the parts of the spring-jack switch of that line, the parts being insulated suitably for the purposes required. The switches for a line on the different boards may be called a "series of switches," and the test-bolts of a line may be called a "series of test-bolts."

Figure 2 of the drawings shows an edge view of a spring-jack switch, such as I use in my multiple switch-board system, with part of the metal frame-work broken away so as to show the position of the plug when it is inserted into the switch. The figure shows the plug inserted into the switch.

a' b' c' d', *a'' b'' c''* and *d''* in Fig. 1 are also edge views of the spring-jack switch, *a''*, *b''*, and *c'* having plugs inserted.

The same letters are used to designate the same parts of the spring-jack switches shown in Figs. 1 and 2.

k is the metal frame-work of the switch, which I also use as a test-bolt.

f is a metal contact-screw passing through the frame-work, *k* and insulated from it by the insulation *e*, which also passes through *k*.

h is the contact-spring of the switch. It is insulated from the frame-work *k*, and is in contact with the point *g* of the screw *f* when the plug is not inserted in the switch. When the plug is inserted, the contact between the point *g* and the spring *h* is broken, and the metal part of the plug is in contact with the spring, as shown.

m m' are insulating-pieces which insulate spring *h* from the metal frame-work *k*.

f' is a connecting-piece in electric contact with screw *f*.

k' is a connecting-piece in electric contact with frame-work *k*.

h' is a connecting-piece in electric contact with spring *h*.

An extension of *k* passes through insulating-pieces *m m'*, connecting-pieces *h' k'*, and contact-spring *h*, and has a screw-thread cut on its end. *n* is a nut which fits this thread and holds the parts in place, as shown.

Fig. 1 of the drawings shows in detail the central-office apparatus and connections in my multiple switch-board system. Figs. 1^a, 1^b, 1^c, and 1^d show in detail subscribers' station apparatus and connections used in the system. Figs. 1^e and 1^f show modifications of subscribers' station apparatus and connections. Fig. 2 shows an edge view of the spring-jack switch used in the system. Fig. 3 represents a cen-

tral-office system of cords, plug, and other apparatus for the use of an operator for making and answering connections and testing. Fig. 4 shows parts of two boards for open-circuit lines with their connections.

D in Fig. 2 represents a switch-plug adapted for use with the switch, and with a portion of its flexible cord attached. C is a solid metal cylinder of the plug with a rounded end, as shown. C′ is the handle of the plug, and is made of some insulating material, as hard rubber. E is a metal strip which makes the connection between the cord and the metal cylinder.

Fig. 1 shows in detail the general arrangement and operation of the central-office apparatus of my multiple switch-board system. A is a broken sectional view of the frame-work of one of the switch-boards required for the central office, and adapted to receive spring-jack switches for all of the lines which center at the office. Four spring-jacks, *a′*, *b′*, *c′*, and *d′*, are shown mounted on this frame-work. A′ is a broken sectional view of the frame-work of another of the switch-boards required for the central office, also adapted to receive spring-jack switches for all of the lines which center at the office. Four spring-jack switches, *a″*, *b″*, *c″*, and *d″*, are also shown mounted on this frame-work, and they are for the same four lines as are the spring-jacks shown on frame-work A. I have shown only two boards in operation. If more were required, they would be fitted up similar to those shown, and the connections between all would be similar to that shown, and such as would be evident to those skilled in the art.

Fig. 1 also shows parts of the four lines to which belong the spring-jacks shown. They are marked "Line No. 1," "Line No. 2," "Line No. 3," and "Line No. 4." To line No. 1 belong spring jacks *a′ a″*. To line No. 2 belong spring-jacks *b′ b″*. To line No. 3 belong spring-jacks *c′ c″*. To line No. 4 belong spring-jacks *d′ d″*.

Figs. 1ª, 1ᵇ, 1ᶜ, and 1ᵈ show parts of lines Nos. 1, 2, 3, and 4, and also their station outfits, which are marked W, X, Y, and Z, respectively. I have represented the usual magneto-bell system of calling with closed-circuit lines and calling-annunciators at the central office, and I have represented two of the lines (lines No. 1 and No. 2) as having their annunciators located at switch-board A, their calls to be attended to at that board. Their annunciators are marked *w* and *z*, respectively. I have represented lines No. 2 and No. 3 as having their annunciators at switch-board A′, and they are marked *x* and *y*, respectively. I have represented at the subscribers' stations the usual forms of telephone apparatus, including battery-transmitter, receiving-telephone, induction-coil, battery, and telephone-switch. The magneto-generators of the station outfits are marked 1, the bells are marked 2, the battery-transmitters 3, the primaries of the induction-coils 4, the secondaries of the induction-coils 5, the batteries 6, the telephone switches 7, and the receiving-telephones 8. I have represented with these outfits the gravity-switch ordinarily used with the hand-telephone. The circuit at each station outfit is as shown, the solid lines representing the main line passing through the generator, bell, transmitter, primary, and secondary of the induction-coil and hand-telephone to ground, and the broken lines representing the local connections, as shown.

It will be seen that the transmitter and primary of the induction-coil are shunted by a branch or derived circuit, in which is a battery and a pair of contact-points of the telephone-switch, and that these points are open when the telephone is on the switch and closed when it is off the switch.

It is evident from an examination of the circuits that when the hand-telephone is off from its switch the battery is on closed circuit with the transmitter and primary of the induction-coil, and that as the two latter are also in the main circuit part of the battery-current will then go to line, the proportion going to line being dependent on the comparative resistance of the derived circuit which contains the transmitter and primary of the induction-coil on the one hand, and, on the other hand, that which includes the rest of the main circuit, according to the well-known law of the distribution of current in derived circuits. It is evident from the circuits that when a telephone is on its switch the battery is open and no current from it goes to line. The battery therefore acts as a transmitter-battery for the subscriber's station outfit, and by sending current to line where it is switched for use with the transmitter, and by sending it only then the same battery also operates as a test-battery, in a manner which will hereinafter be described. The telephone of station Z is shown as on its switch. The telephones of W, X, and Y are shown as not on their switches.

The connections of the lines through their spring-jacks on the different boards and to their test-bolts and through their calling-annunciators to ground are shown in Fig. 1. The main-line circuits may be traced as follows: The circuit of line No. 4, for instance, beginning at the ground in the central office, passes through its annunciator *z* and thence through wire *d″″* and connecting-piece *f′* of spring-jack *d′* to screw *f*, and thence through spring *h* and connecting-piece *h′* of that spring-jack to wire *d‴*, and thence to connecting-piece *f′* of spring-jack *d″*, and thence through screw *f*, spring *h*, and connecting-piece *h′* of that spring-jack to wire *d″*, which wire is connected directly to line No. 4, and through connecting-pieces *k′ k′* to test-bolts *k k* of spring-jacks *d′ d″*. The circuit then passes along the line No. 4 to the station outfit *z*, and through that outfit, as shown in Fig. 1ᵈ. If there were more than two switch-boards, each having a spring-jack for the line, the circuit would be from one spring-jack to another in the manner

similar to that shown, so that all the contact-springs would be in the circuit, and the circuit, after passing through the contact-spring *h* of the last spring-jack, would be connected to all the pieces *k* of its series and to line. Line No. 2 could be traced in the same way, except that after passing through its annunciator it is first connected through the spring-jack of its switch on switch-board A′, where its calls are to be attended to. Every other line of the system would in like manner be connected to its series of switches and of test-bolts and to ground and to its station outfit.

It will be seen from the description of the apparatus and the connections, as shown, that when there is no plug in any switch of the series of a line the circuit of the line through the boards and its annunciator to ground is unbroken, and when there is a plug in any switch of the series the circuit of the line to ground through the annunciator is broken and the line is in electric connection with the cord which belongs to the plug.

It is evident that when a plug is inserted into the switch of any line at any board and its corresponding plug electrically connected with it is inserted into the switch of another line the two lines are disconnected from their annunciators and the ground at the central office and are connected to each other.

It is also evident that all the pieces *k* of a series of switches belonging to a line are in connection with the line, whether the line is in use or not at any board.

Fig. 3 represents a central-office system of connecting-cords with plugs, keys, switches, annunciators, telephone, battery, and circuits for answering, calling, testing, and clearing out subscribers' lines. It represents the operator's telephone as connected with the ground on one and with the keys, switches, &c., on the other side to the connecting-cords. It represents two pairs of cords with their keys, switches, and annunciators, and with one telephone and one signal battery or generator, the whole being intended as the outfit of one operator at one board of the central office. Other pairs of cords with their keys, &c., could in like manner be connected to the operator's telephone and signal-battery, giving to each operator as many pairs of cords, &c., as she might require in order to make the connections called for by the subscribers assigned to her.

In Fig. 1, O and O′ represent two systems of cords, &c., with telephones and batteries for two operators—one at each board. Only one pair of cords is shown in each of these two systems.

v and *v′* in Figs. 1 and 3 are clearing-out annunciators.

p and *p′* are three-point lever-switches, *i i′ j j′* being the contact-bolts on which the levers can be placed at the will of the operators.

q q′ are spring-keys for calling.

r r′ are spring-keys for listening for the order and for clearing-out purposes.

u u′ are the calling-batteries or generators.

l l′ are the operators' telephones.

The levers of the switches remain normally, or when their cords are not in use for switching, on bolts *i i′*. When a pair of cords is in use and the connection is completed between two subscribers' lines, the lever is moved to the other bolt of the switch.

D′ D² and D′¹ D′² represent two pairs of cords with their plugs. The right-hand cords, or the ones marked D² D′² are to be used to make connections with the spring-jacks of the calling subscribers. The cords marked D′ D′¹ are to be used to make connections with the spring-jacks of the subscribers who are to be called. The circuits are substantially as shown. These systems may be called the "operators' systems of cords."

The operation of the complete telephone apparatus and system described above is as follows: When a calling-annunciator at a board indicates a call, the operator places one of her plugs, which are intended to be used for calling subscribers' lines, into the spring-jack of the line on which the call is indicated, and pressing on the listening-key corresponding to that plug finds out who is wanted by the person who has called. She then takes the other plug of the pair she is using and places it on the test-bolt of the line wanted, at the same time holding her telephone to her ear. If, now, the station outfit of the subscriber whose line is being tested is in use, or, in other words, if the telephone at his station is off from its switch, the operator hears a click or sound in her telephone, caused by the battery-current which is then going to line from the station-battery, she will hear as many clicks as she makes and breaks the current in testing. She knows by the click that the subscriber's outfit is already in use, and notifies the calling subscriber to that effect and removes the plug from his spring-jack. If, on the other hand, the station outfit of the subscriber who is wanted is not in use, or, in other words, if the telephone is on the hook, the operator will hear no click, and consequently knows that the station outfit is not in use. She then inserts the plug in the switch of the line, and, removing the lever of the switch corresponding to the cords she is using from its bolt *i*, presses on the key *q* corresponding to the cords, and thereby calls the subscriber wanted. She then moves the lever *p* to the bolt *j*, and the two lines are connected together for conversation. Fig. 1 shows lines No. 1 and No. 2 connected together for conversation on board A′. Figs. 1ª and 1ᵇ show the station outfits of these lines with their telephones off from their switches. By pressing on *r′* the operator may listen to the conversation going on in the circuit of the two lines thus connected. By pressing on *q′* the signaling-current will be sent to both lines, and on *v′* she may receive the clearing-out signal to disconnect. On switch-board A, Fig. 1, the cord D² of system O is connected with the spring-jack of line No. 3, and the operator

may, on pressing on key *r*, converse with the subscriber at station outfit Y. The telephone at Y is off from its switch for conversation. Now, if the operator places the plug D′ on the test-bolt at *a′* or *b′*, she finds that the outfits of lines Nos. 1 and 2 are in use, and she proceeds no further in making connection with those lines. If she places the plug on the test-bolt at *d′*, she will find that the station outfit of line No. 4 is not in use, and she may then connect to that line and call the station and complete the connection in the manner indicated above.

It will thus be seen that in this system, constructed and operated as described above, any two lines centering at any office can be readily connected and disconnected at any board of the office and that any operator may readily test to determine whether any line is in use or not.

I do not limit myself to the form of central-office switch-board which I have shown. My system of testing may be applied to any form of switch-boards suitable for telephone-exchanges, the only additional requirement being to provide a series of test-bolts—one bolt for each line on each board—the bolts of a series being connected with each other and with the line in such a way that they will always be connected with the line in whatever way it may be switched.

I do not limit myself to the gravity form of telephone-switch in the station outfits. Any known forms of telephone-switches might be used with proper arrangement of parts and connections.

In the modifications of subscriber's station apparatus shown in Figs. 1^e and 1^f the same parts are indicated by the same numbers, as in Figs. 1^a, 1^b, 1^c, and 1^d.

9 in Fig. 1^e indicates a resistance-coil of suitable resistance, and 10 in Fig. 1^f indicates an extra battery. The circuits in the two figures are substantially as shown, the solid lines being for the main line and the broken lines for the local circuits.

It will be seen that in the station apparatus shown in Figs. 1^a, 1^b, 1^c, 1^d, and 1^e electric current from the transmitter-battery will go to line when the subscriber's telephone-switch is in position for the telephone to be used, and none will go to line when it is not in that position, and that in the station apparatus shown in Fig. 1^f an extra battery is used, which sends a current to line when the telephone is being used, and only then in the combinations which I shall hereinafter claim.

I do not wish to limit myself to any particular apparatus for sending currents to line.

The battery-current sent to line when the line is in use for conversation should be sufficiently strong to be indicated by the test-receiving apparatus used at the central office. It should, however, not be strong enough to operate the clearing-out annunciator, if one is used. I have found by experience that with the apparatus generally in use in telephone-exchanges, when connected and used as shown in the drawings, the current is of the right strength to obtain these results. I prefer to use a telephone as the test-receiving instrument, as it is delicate enough to indicate a current of the strength mentioned above and can be conveniently used for this purpose and at the same time for the other operations of the attendant. A galvanometer or other suitable test-receiving instrument might, however, be used.

It is preferable that the batteries of the station outfits be so connected that they send the same polarities to line when their telephones are in use.

It will be seen that when the batteries are thus connected, and two lines are connected together for conversation with a clearing-out annunciator in their circuit, the batteries of the two lines will act in opposite directions on the clearing-out-annunciator magnet, and the effective current acting on the magnet will be merely that due to the difference, if any, between the strength of the two batteries. Their effect, however, on a test-receiving instrument grounded on one side and connected on its other side to the circuit of the two lines will be that of two batteries acting together in multiple circuit, one in each line. Should, however, the batteries in the subscriber's station apparatus of two lines connected together for conversation be connected into their circuit in such a manner that the currents from the two batteries pass in the same direction, their effect on the test-receiving instrument would be that of two batteries sending currents of opposite direction through it, and should the batteries send equal strength of current through it no test-signal would be received, even when the lines were in use. To prevent this occurrence, I connect all the batteries, so that they will all send the same polarities of current to their lines.

I have shown closed-circuit lines grounded at the subscribers' stations. If desired, any of the lines might be continued back to the office and there grounded.

My system of testing is applicable to open-circuit as well as to closed-circuit systems of exchanges. If the wires are normally open at the central office, the test-bolt and the switch of a wire on each board may be one and the same, and may be a metallic socket adapted to receive the switch-plug.

Fig. 4 shows two multiple switch-boards for open-circuit lines with the metal sockets mentioned above, adapted both to receive the switch-plug and to perform the office of a test-bolt for its line. *ms ms* in this figure represent these metallic sockets.

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

1. In a telephone-subscriber's station outfit, the combination of a battery-transmitter, a battery, and a switch, said switch having a pair of contact-points which are closed when the switch is in position for the telephone to be used, and not otherwise, the transmitter being

in the circuit of the line and being shunted by a branch or derived circuit, in which are said battery and said pair of contact-points, substantially as set forth.

2. In a telephone-subscriber's station outfit, the combination of a resistance, (of whatever kind,) a battery, and a switch, said switch having a pair of contact-points which are closed when the switch is in position for the telephone to be used, and not otherwise, the resistance being in the circuit of the line, and being shunted by a branch or derived circuit in which are said battery and said pair of contact-points, substantially as set forth.

3. In a telephone-subscriber's station outfit, a battery-transmitter and the primary of its induction-coil in the circuit of the line, a switch having a pair of contact-points, and a battery, said battery and said pair of contact-points being in a branch or derived circuit which shunts said transmitter and primary of its induction-coil, and said pair of contact-points being closed when the switch is in position for the telephone to be used, and not otherwise, substantially as set forth.

4. In a telephone-exchange system, a telephone-line grounded at its outer end, a battery-transmitter with the primary of its induction-coil, a battery, and a switch at the subscriber's station, said switch having a pair of contact-points which are closed when the switch is in position for the telephone to be used, and not otherwise, said transmitter, with its induction-coil, being in the circuit of the lines, and said battery and said pair of contact-points being in a branch or derived circuit which shunts said transmitter with its primary of the induction-coil, in combination with a test-receiving instrument at the central office grounded on one side, and a switch-testing plug or device connected to said instrument on its other side, whereby an operator may at will connect it to the circuit of said line, substantially as set forth.

5. In a telephone-exchange system, a telephone-line grounded at its outer end, a resistance, (of whatever kind,) a battery, and a switch at the subscriber's station, said resistance being in the circuit of the line, said switch having a pair of contact-points which are closed when the switch is in position for the telephone to be used, and not otherwise, and said battery and said pair of contact-points being in a branch or derived circuit which shunts said resistance, in combination with a test-receiving instrument grounded on one side, and a switch-testing plug or device connected to said instrument on its other side, whereby an operator may at will connect it to the circuit of said line, substantially as set forth.

6. In a telephone-exchange system, the combination of a telephone-line grounded at its outer end, two or more switch-boards, at either of which said line may be switched for conversation, and test-receiving instruments, one at each board, each instrument being grounded on one side and connected on its other side to a switch-testing plug or device to connect it for testing with the circuit of the line, with a resistance, (of whatever kind,) a battery, and a switch at the subscriber's station, said resistance being in the circuit of the line, said switch having a pair of contact-points which are closed when the switch is in position for the telephone to be used, and not otherwise, said battery and said pair of contact-points being in a branch or derived circuit which shunts said resistance, substantially as set forth.

7. In a telephone-exchange system, two telephone-lines grounded at their outer ends and connected together at the exchange-office for conversation, a battery, and a switch at the subscriber's station of each line, each switch sending a current to line from its battery when the switch is in position for the telephone to be used, and not otherwise, and said batteries being so connected that their currents go in opposite directions through the circuit, in combination with a test-receiving instrument at the central office grounded on one side, and a switch-testing plug or device connected to the other side of said instrument, whereby an operator may at will connect it to the circuit of either line, substantially as set forth.

8. In a telephone-exchange system, two or more switch-boards, at either of which the same lines may be switched for conversation, two lines temporarily connected together at one of said boards, a battery, and a switch at the subscriber's station of each line, each switch sending a current to line from its battery when the switch is in position for the telephone to be used, and not otherwise, and said batteries being connected so that their currents go in opposite directions through the circuit, in combination with test-receiving instruments, one at each board, each instrument being grounded on one side and connected on its other side to a switch-testing plug or device, whereby an operator may at will connect it to the circuit of either line, substantially as set forth.

9. In a telephone-exchange system, two telephone-lines grounded at their outer ends and connected together at the central office for conversation, a clearing-out annunciator in the circuit of said lines at the central office, a battery, and a switch at the subscriber's station of each line, each switch sending a current to line from its battery when the switch is in position for the telephone to be used, and not otherwise, and said batteries being so connected that their currents go in opposite directions through the circuit, in combination with a test-receiving instrument at the central office grounded on one side, and a switch-testing plug or device connected to the other side of said instrument, whereby an operator may at will connect it to the circuit of either line, substantially as set forth.

10. In a telephone-exchange system, a pair of central-office cords with plugs adapted for

use with the line-switches, in combination with an operator's telephone and a switch, said cords being normally, or when not in use for conversation between two subscribers, disconnected from each other, and one of them grounded through the operator's telephone, and said switch having contact-points to disconnect said cord from its ground-connection through the telephone, and at the same time connect it with the other cord for conversation.

11. In a telephone-exchange system, a pair of central-office cords with plugs adapted for use with line-switches, in combination with an operator's telephone, a switch, and a key, said cords being normally, or when not in use for conversation, disconnected from each other and one of them grounded through the operator's telephone, said key having a pair of contact-points normally open, but closed at the will of the operator, said points being in a branch circuit from the other cord through the telephone to the ground, and said switch having contact-points to disconnect said first-mentioned cord from the ground and connect it with the other cord for conversation.

MILO G. KELLOGG.

Witnesses:
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