

(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,396.

Patented Oct. 26, 1897.

Fig. 1.

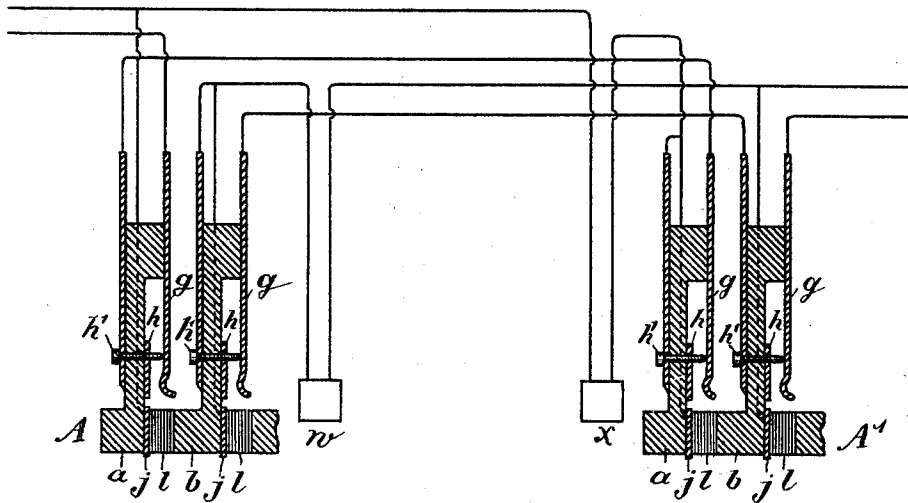


Fig. 2.

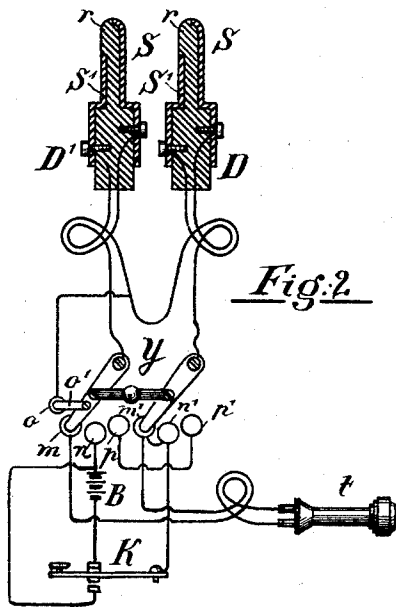
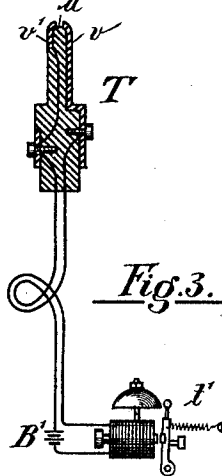


Fig. 3.



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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. 592,396, dated October 26, 1897.

Application filed May 16, 1891. Serial No. 392,965. (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
5 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.

10 My invention especially relates to a telephone-exchange system in which the lines are metallic-circuit lines and in which the necessary switching between the lines is accomplished by means of pairs of double or loop
15 plugs connected together by double flexible cord conductors.

It consists, first, of a system of testing the lines at any board to determine whether or not they are in use; secondly, of an organization of loop-switches and connections for
20 said cords by which the movements required of the operator in making the necessary connections and disconnections are few and convenient to make, and, thirdly, of an arrangement of the annunciators and switches of the
25 different lines by which special clearing-out annunciators are not required.

In the accompanying drawings, illustrating my invention, Figure 1 represents sectional
30 views of sections of two multiple switchboards and the main-line-contact office connections and apparatus of the two lines connected to the two switchboards. Fig. 2 represents a diagram of an operator's cord system and apparatus necessary to illustrate my invention.
35 Fig. 3 represents an operator's test system.

I place as many switchboards in the central office as are found necessary or desirable in order to properly operate the exchange. On
40 each board is a spring-jack switch for each line. Each switch has a contact-spring which normally connects with a contact-point and is separated from the point while a plug is inserted into the switch and has a contact-piece insulated from the rest, (except by the
45 circuit connections.) To the contact-point is attached an extension-piece or connection along the surface of the switch-hole, by means of which one of the contact-pieces of the loop
50 test-plug, hereinafter described, forms connection with the contact-point when the plug

is inserted, as hereinafter described. The insulated contact-piece mentioned above is also placed along the surface of the switch-hole and preferably in front of said extension-
55 piece to the contact-point, and is so placed that one of the contact-pieces of the loop-switch plugs, hereinafter described, forms connection with said contact-piece when the plug is inserted. Said plugs are so constructed
60 and said contact-pieces and extension-pieces of the switches are so placed that when the test-plug is inserted into a switch the contact-piece of the plug does not come into contact with said contact-piece, and when a switch-
65 plug is inserted into a switch the contact-piece of the plug does not come into contact with the extension-piece or point of the switch.

In Fig. 1, A A' are sectional views of sections of the two switchboards shown. *g g* represent the springs of the different switches;
70 *h' h'*, the contact-points of the switches, on which the springs normally rest, and *h h* the extension-pieces of the points, placed along the surface of the holes of the switches in front of the points. *j j* are the insulated contact-pieces of the switches, also placed along the holes of their respective switches and preferably in front of the extension-pieces.
80 *a b* are rubber strips on which the metal parts of the switches are mounted and through the fronts of which are the switch-holes *l l*. These holes are rectilinear holes and are adapted to receive the loop-plugs mentioned above and
85 to cause them to operate the switches, as described. *w* and *x* are calling-annunciators, one for each line shown and each connected into the circuit of its line, as will hereinafter be described. Two metallic-circuit lines are
90 shown in the figure, and they are connected to their respective boards as follows and as shown: One side or branch of the line is connected to the contact-pieces *j j* of its switches on the several boards. The other side or
95 branch of the line passes, successively, through the pairs of contacts *g h* of its switches on the several boards, passing in each case to the spring first. It then passes to the other side or branch of the line, (to which the
100 contact-pieces *j j* are connected.) The annunciator of the line is placed in the circuit

of said first-mentioned branch of the line between the contact-piece j which is connected farthest from the subscriber's station and the contact-piece j which immediately precedes it and is located at the same board as said contact-piece j which is farthest from the subscriber's station. The two branches of the line are normally on closed circuit at the subscriber's station and may be provided with any usual and appropriate subscriber's-station apparatus.

In the operator's cord system shown in Fig. 2, $D D'$ are a pair of loop-switch plugs adapted for use with the switches shown in Fig. 1. $r r$ are the rubber insulations of the plugs. $S S'$ are the two contact-pieces of the plug. The plugs are constructed and the contact-pieces are arranged so that when a plug is inserted into a switch the spring is pressed away from its contact-point, the contact-piece S forms connection with the spring g , the contact-piece S' forms connection with the contact-piece j of the switch, and the contact-point h' is insulated from the contact-pieces of the plug. The plugs should be inserted into the switches in such a direction that they form the connections, as above described.

Y is the looping-in switch for the pair of cords shown. t is the operator's telephone. B is her calling-generator, and K is a key or switch. The looping-in switch has two levers and three pairs of contact-points, on which the levers may be alternately placed at the will of the operator. One pair of the contact-points are marked $m m'$, and they are connected by a loop which contains the operator's telephone. The pair adjoining them are marked $n n'$, and they are connected by a loop which contains the generator and the normally closed pair of contact-points of the operator's key and are connected to her telephone, as will hereinafter be described. The next pair are marked $p p'$, and they are connected by a simple loop. When the levers pass from $m m'$ to $p p'$, they make contact with $n n'$. One contact-piece of one plug of the pair of plugs is connected by flexible conductor to one contact-piece of the other plug. The two other contact-pieces of the plug are connected by flexible conductors to the two levers of the switch.

$o o'$ are a pair of contact-points, of which o is a stationary point and is connected by a circuit-wire to the cord-circuit which connects the two contact-pieces of the plugs which are not directly connected to the switch-levers, and o' is a contact-point which is connected to one of the levers, as shown, and moves with the lever. The contact-points $o o'$ are in contact when the switch-levers are on the contact-points $m m'$ and are out of contact when the levers are moved to the other points of the switch.

The key K contains a contact-lever and two contact-points, with one of which the lever normally connects, and with the other of which it connects when it is depressed or

moved by the operator away from its first-mentioned point. The contact-points $m' n'$ are connected together and the lower (or normally open) contact-point of the key is connected to contact-point n of the switch, but not through the calling-generator. Only one pair of switch-plugs, with their cords and looping-in switch, are shown. Other pairs as are found desirable may be added to the operator's system in a way which will be apparent to those skilled in the art. She needs but one telephone, calling-generator, and key or switch. The levers of each looping-in switch normally rest on the contact-points $m m'$.

In the operator's test system shown in Fig. 3, T is the loop test-plug, t' is the test receiving instrument, and B' is a test-battery. u is the rubber insulation of the plug, and $v v'$ are its contact-pieces. The plug is constructed and the pieces are arranged so that when the plug is inserted into any switch the spring is pressed away from its contact-point, the contact-piece v forms connection with the spring g , the contact-piece v' forms connection with the extension-piece h , and the contact-piece j of the switch is not in contact with the contact-pieces of the plug. The plug should be inserted into the switches in such a direction that they form the connection as above described. The two contact-pieces $v v'$ of the plug are connected by a flexible conducting-loop in which is the test receiving instrument. Each operator has a cord system and a test system, and they are conveniently mounted at her board for her work. The conducting-cords of the plugs should be of such length that she can connect any plug with any switch at her board.

The operation of the switch system is as follows: When an operator receives a call on the annunciator of a line, she places the plug D of a pair of her plugs in the switch of the line. By so doing she opens the closed circuit of the line and loops her telephone into the circuit. The closed circuit of the line is opened at the pair of contacts $g h$ of the switch. The two cords of the plug are connected to the two branches of the line by the connection of the two contact-pieces of the plug with the two contact-pieces g and j of the switch, and the two cords are bridged or connected by the contacts $o o'$ of the looping-in switch. When the operator finds out by conversation what line is wanted, she tests the line wanted, as will be hereinafter described, and if she finds it is not busy she places the plug D' of the pair in the switch of the line, opening the closed circuit of the line and connecting its two branches to the cord-circuits of the plug. She then moves the levers of the looping-in switch, so that they rest on the points $n n'$. By so doing the bridge connection between the cords (at $o o'$) is removed and a signal-current from the operator's generator goes to the metallic circuit. She then moves the levers of the switch, so that they

rest on $p p'$, and the lines are connected in metallic circuit for conversation with neither the operator's telephone nor generator in the circuit. When the operator receives the clearing-out signal, she will remove the plugs from the switches and move the levers of the looping-in switch, so that they rest on the points $m m'$, when they are ready to be used for another connection.

The test receiving instrument and battery should be so constructed and adjusted to each other and the circuits of the exchange that the instrument will sound or respond when it and the battery are looped into the normal closed circuit of any line of the exchange, but will not respond when they are in an open circuit or the line in which the test is made is looped into circuit with any other line and has, therefore, the resistance of both lines in its circuit. This construction and adjustment can be readily accomplished and may be facilitated, if desired, by the addition of artificial resistances, so as to equalize the resistance of the various lines of the exchange. This construction and adjustment depend on the fact that an electromagnet may be readily made so as to operate when a battery and a certain resistance are in circuit with it and not to operate when the resistance is considerably larger. This operation can be obtained in different ways, dependent on the style of the electromagnet, the number of convolutions of its coil, the size of the battery, and the adjustment of the retractile spring. These parts should be such that the electromagnet will be actuated when the test system is looped into the normal circuit of any line of the exchange, but will not be actuated when the circuit is open or the additional resistance of another line is introduced.

The test system is as follows: When an operator at any board tests any line, she places her test-plug in the switch of the line and by so doing connects the two contact-pieces of the plug with the two contact-points $g h$ of the switch. If the line is not switched, the test receiving instrument and battery will be included in the closed circuit of the line and the instrument will sound, because on account of the low resistance of the circuit the current which passes through the test receiving instrument will be sufficient to attract and move its armature, thus indicating that the line is free to be connected to. If, however, when the test is made the line is switched at some board and the plug is inserted in the cut-off portion of the line, the circuit of the test receiving instrument is open at the contact-points $g h$ of the switch used in switching and the instrument will not sound, because the test receiving instrument is not on closed circuit with its battery and its armature is not attracted at all. If, again, when the line is switched the test-plug is inserted in the portion of the circuit which is included with the other line, then the instrument will not sound, because the resistance is that of two lines

combined, and on account of the large resistance of the circuit which then contains the test receiving instrument and battery sufficient current will not pass through the test receiving instrument to move its armature. The test therefore depends on the marginal adjustment of the test receiving instrument to the battery and the circuits, which will cause the instrument to sound when included in the normal closed circuit of a line, but will not sound when the resistance of two lines is included in the circuit with it and the battery, although even then current is passing through the magnet of the instrument. When, therefore, the test is made and the instrument does not sound, the operator knows that the line is switched at some board.

When a call is received on a line and it is answered and the line is connected with another line, as described, the annunciator of the line in which the call originated is in their circuit and the annunciator of the other line is not included in the circuit. As the annunciator which is in the circuit is located at the board where the connection is made any clearing-out signal sent over the circuit will be received and can be attended to at the board where the connection is made. This system therefore provides for a clearing-out annunciator in the circuit of any two lines connected together without requiring a special clearing-out annunciator for each pair of cords.

When two lines are connected together for conversation and the annunciator of one of the lines is in circuit with them for clearing-out purposes, the combined circuit is one of metallic continuity throughout, unobstructed by condenser or other forms of break, whether either subscriber's telephone is on its switch or not, so that any clearing-out current sent by either subscriber has a free, unobstructed, and unbroken circuit to operate the annunciator and cause the clearing-out signal to be indicated. The annunciators should of course be so related to the test-batteries that the batteries will not cause them to operate when included for testing into closed circuit with them. This may be provided for by the usual arrangement of polarized annunciators properly connected in the circuit or in other ways.

Should the operator at any time desire to listen into the circuit of two lines which are connected together for conversation, she depresses the lever of the key K and while the lever is in that position moves the commutator-piece, so that the switch-levers rest on $m m'$, and her telephone is thereby included in the metallic circuit of the line. By pressing on key K when the levers are moved the circuit in which is the calling-generator B is opened and calling-current will not be sent to line while the levers are in contact with $n n'$.

I claim as my invention—

1. In a telephone-exchange system, a metallic-circuit line normally on closed circuit and switching apparatus to open said closed cir-

cuit at the central office and loop the line into a continuously metallic or unbroken metallic circuit with another line, in combination with a test receiving instrument and battery and switching apparatus by which the instrument and battery may be looped into the normal circuit of the line, the instrument being so constructed and adjusted to the battery and circuits by its marginal adjustment substantially as described that it will sound when thus looped and the circuit in which it is included is neither open nor contains the additional resistance of another telephone-line, but not otherwise, substantially as set forth.

2. In a telephone-exchange system, multiple switchboards and a metallic-circuit line connected to each of the boards and normally on closed circuit, and switching apparatus to open said closed circuit at the central office and loop the line into a continuously metallic or unbroken metallic circuit with another line, in combination with test receiving instruments, one at each board and connected in a loop with a test-battery, and switching apparatus by which each instrument with its battery may be looped at its board into the normal circuit of the line, the instrument being so constructed and adjusted to the battery and circuits by its marginal adjustment substantially as described that it will sound or respond when thus looped and the circuit is neither open nor contains the additional resistance of another telephone-line, but not otherwise, substantially as set forth.

3. In a telephone-exchange system, multiple switchboards, metallic-circuit lines, each connected to each board and normally on closed circuit and switch apparatus to connect any two lines into a continuously metallic circuit and an annunciator in said circuit, in combination with test receiving instruments and test-batteries, one of each at each board, and switch apparatus by which each instrument with its battery may be looped into the normal circuit of any line, the instrument being so constructed and adjusted to the battery and circuits by its marginal adjustment substantially as described that it will sound or respond when thus looped and the circuit is neither open nor contains the combined resistance of two lines, but not otherwise, substantially as set forth.

4. In a telephone-exchange system, multiple switchboards, and a metallic-circuit line normally on closed circuit and passing normally successively through pairs of switch contact-points, one pair on each board, in combination with switch apparatus at each board by which the two sides or branches of the line may be connected with the two sides or branches of any of the other lines into a continuously metallic circuit and when they are thus connected at a board said pair of switch contact-points at the board is open and loop test-plugs, one at each board, the two contact-pieces of which are connected to the two sides, respectively, of a loop which

contains a test receiving instrument and battery each plug being adapted to be inserted into the line-switch at its board and when inserted to disconnect its said pair of contact-points and connect its said pair of contact-points and connect the two contact-pieces of the plug with said points respectively, the instrument being so constructed and adjusted to the battery and circuits by its marginal adjustment substantially as described that it will sound or respond when thus switched into circuit and the circuit is neither open nor contains the combined resistance of two telephone-lines, but not otherwise, substantially as set forth.

5. In a telephone-exchange system, a telephone-circuit line normally on closed circuit and switching apparatus to open said closed circuit at the central office and loop the line into a metallically continuous or an unbroken metallic circuit with another line, in combination with a test receiving instrument and battery and switching apparatus by which the instrument and battery may be looped into the normal circuit of the line, the instrument being so constructed and adjusted to the battery and circuits by its marginal adjustment substantially as described that it will sound when thus looped and the circuit in which it is included is neither open nor contains the additional resistance of another telephone-line, but not otherwise, substantially as set forth.

6. In a telephone-exchange system, multiple switchboards and a telephone-circuit line connected to each of the boards and normally on closed circuit and switching apparatus to open said closed circuit at the central office and loop the line into a metallically continuous or unbroken metallic circuit with another line, in combination with test receiving instruments, one at each board and connected in a loop with a test-battery, and switching apparatus by which each instrument with its battery may be looped at its board into the normal circuit of the line, the instrument being so constructed and adjusted to the battery and circuits by its marginal adjustment substantially as described that it will sound or respond when thus looped and the circuit is neither open nor contains the additional resistance of another telephone-line, but not otherwise, substantially as set forth.

7. In a telephone-exchange system, multiple switchboards, telephone-circuit lines, each connected to each board and normally on closed circuit and switch apparatus by which any two of the lines may be connected together, a continuously metallic or an unbroken metallic circuit and an annunciator for clearing-out signals in said circuit, in combination with test receiving instruments and test-batteries, one of each at each board, and switch apparatus by which each instrument with its battery may be looped into the normal circuit of any line, the instrument being so constructed and adjusted to the battery and circuits

by its marginal adjustment substantially as described that it will sound or respond when thus looped and the circuit is neither open nor contains the combined resistance of two lines, but not otherwise, substantially as set forth.

8. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are connected to the two contact-pieces, respectively, of the other by two flexible-cord circuits, said two cord-circuits being normally or while they are not in use for switching bridged or cross-connected by a circuit connection and one of them containing normally an operator's telephone, in combination with a switching device having two levers in one of said cord-circuits connected to the two plug-contacts respectively of that cord-circuit, a pair of contacts connected through the operator's telephone with which said levers in their normal position connect, another pair of contacts in electrical connection with which said levers may by one motion be connected, and a pair of contacts connected to the two cord-circuits, respectively, closed to each other when the levers are in their normal position but otherwise open, by which the operator may in one motion both open such bridge or cross connection and switch the telephone from the cord-circuit, substantially as set forth.

9. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are connected to the two contact-pieces of the other, respectively, by two flexible-cord circuits, said two cord-circuits being normally bridged or cross-connected and one of them containing normally an operator's telephone, in combination with a switching device having two levers in one of said cord-circuits connected to the two plug-contacts respectively of that cord-circuit, a pair of contacts connected through the operator's telephone with which said levers in their normal position connect, another pair of contacts connected through a calling-generator with which said lines may by one motion be connected, and a pair of contacts connected to the two cord-circuits, respectively, closed to each other when the levers are in their normal position but otherwise open, by which the operator may in one motion open such bridge or cross connection, switch the telephone from and the calling-generator into one of the cord-circuits, substantially as set forth.

10. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are connected to the two contact-pieces of the other, respectively, by two flexible-cord circuits, said two cord-circuits being normally bridged or cross-connected and one of them containing normally an operator's telephone, in combination with a switching device having two levers in one of said cord-circuits connected to the two plug-contacts respectively of that cord-circuit, a

pair of contacts connected through the operator's telephone with which said levers in their normal position connect, a pair of contacts connected through a calling-generator with which said levers in their next position connect, another pair of contacts in electrical connection with which said levers may by one motion be connected, and a pair of contacts connected to the two cord-circuits, respectively, closed to each other when the levers are in their normal position but otherwise open, by which the operator may open such bridge or cross connection, switch the telephone out of the circuit, switch the calling-generator into one of the cord-circuits and finally leave the cord-circuits both unbridged and unconnected with either telephone or generator, substantially as set forth.

11. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are connected to the two contact-pieces of the other, respectively, by two flexible-cord circuits, said two cord-circuits being normally bridged or cross-connected and one of them normally containing an operator's telephone, in combination with a calling-generator, a switch for said plugs, having a pair of contacts normally closed and connected to the two cord-circuits to make such bridge connection and having also contacts and connections for said telephone and generator, by which the operator may open such bridge or cross connection and then switch at will either the telephone or the generator into one of the cord-circuits, substantially as set forth.

12. In a telephone-exchange system, a pair of loop-switch plugs the two contact-pieces of one of which are connected to the two contact-pieces of the other, respectively, by two flexible-cord circuits, said two cord-circuits being normally bridged or cross-connected and one of them containing normally an operator's telephone, in combination with a switch for said plugs having a pair of contacts normally closed and connected to the two cord-circuits to make such bridge connection, two loops, one containing the telephone and another a calling-generator, connected on their two sides to contacts in one of said cord-circuits and a movable commutator, by which the operator may open such bridge or cross connection, switch either the telephone or the generator into one of the cord-circuits, and leave the circuits unconnected with either, substantially as set forth.

13. In a telephone-exchange system, two metallic-circuit lines temporarily connected together into metallic circuit for conversation and their circuit then bridged or cross-connected by a circuit connection at the central office and containing an operator's telephone, in combination with a switching device having two levers connected respectively to the two terminals of one side of said metallic circuit, a pair of contacts connected through the operator's telephone with which said levers in

their normal position connect, another pair of contacts in electrical connection with which said levers may be connected, and a pair of contacts connected to the two sides of the circuit, respectively, closed to each other when the levers are in their normal position and only then to close such bridge connection, by which the operator may open such bridge or cross connection and switch the telephone from the circuit, substantially as set forth.

14. In a telephone-exchange system, two metallic-circuit lines temporarily connected together into metallic circuit for conversation and the circuit then bridged or cross-connected by a circuit connection and containing an operator's telephone, in combination with a switching device having two levers connected respectively to the two terminals of one side of said metallic circuit, a pair of contacts connected through the operator's telephone with which said levers in their normal position connect, another pair of contacts in electrical connection with which said levers may, by one motion, be connected, and a pair of contacts connected to the two sides of the circuit, respectively, closed to each other when the levers are in their normal position and only then to close such bridge connection, by which the operator may by one motion open such bridge or cross connection and switch the telephone from the circuit, substantially as set forth.

15. In a telephone-exchange system, two metallic-circuit lines temporarily connected together into metallic circuit for conversation with the circuit bridged or cross-connected at the central office and containing an operator's telephone, in combination with a calling-generator and a switch having two levers connected respectively to the two terminals of one side of said metallic circuit, a pair of contacts connected through the operator's telephone with which said levers in their normal position connect, another pair of contacts connected through the calling-generator with which said levers may by one motion be connected and a pair of contacts connected to the two sides of the circuit, respectively, closed to each other when the levers are in their normal position, and only then to close such bridge connection, by which the operator may in one motion open such bridge or cross connection and switch the telephone

from and the generator into the circuit, substantially as set forth.

16. In a telephone-exchange system, two metallic-circuit lines temporarily connected together into a metallic-circuit line for conversation with their circuit bridged or cross-connected at the central office and containing an operator's telephone, in combination with a calling-generator and a switch having two levers connected respectively to the two terminals of one side of said metallic circuit, a pair of contacts connected through the operator's telephone with which said levers in their normal position connect, another pair of contacts connected through the calling-generator with which said levers in another position connect, another pair of contacts in electrical connection with which said levers in a third position connect, said levers being adapted to be moved by one motion from their normal position to the second-mentioned pair of contacts and finally to the third-mentioned pair of contacts, and a pair of contacts connected to the two sides of the circuit, respectively, closed to each other when the levers are in their normal position, and only then to close such bridge connection, by which the operator may in one motion open such bridge connection, switch the telephone from and the generator into the circuit and finally leave the circuit unbridged and unconnected with either telephone or generator, substantially as set forth.

17. In a telephone-exchange system, two metallic-circuit lines temporarily connected together into a metallic circuit for conversation and the circuit then bridged or cross-connected by a circuit connection in the central office, and an operator's telephone in the direct metallic circuit of the two lines thus connected together, in combination with an operator's telephone and a looping-in switch by which the operator may open such bridge or cross connection and switch said telephone into or out of the circuit, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:

FRANK S. OBER,
EDWARD C. DAVIDSON.