(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,401. Patented Oct. 26, 1897.

Fig. 1.

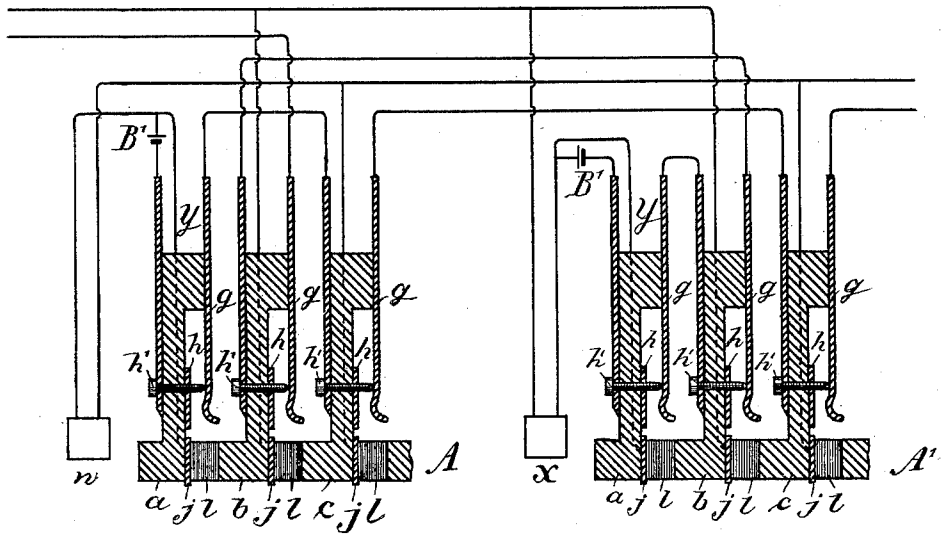


Fig. 2.

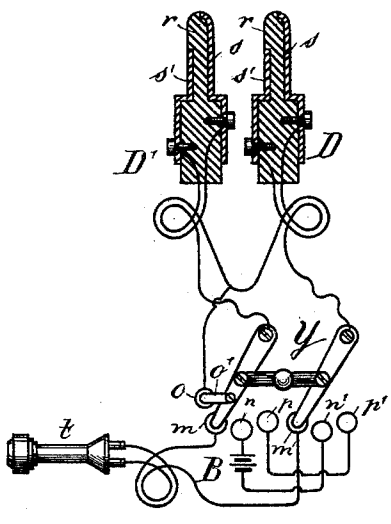


Fig. 3.

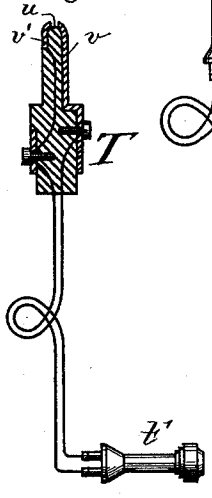
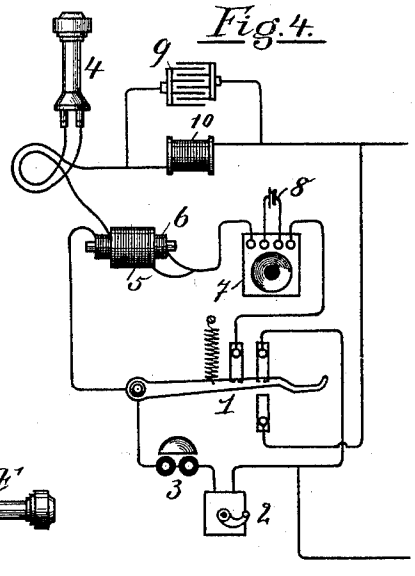


Fig. 4.



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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. 592,401, dated October 26, 1897.

Application filed May 19, 1891. Serial No. 393,272. (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 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 plugs connected together by double flexible conductors.

It consists, first, of a system of testing the lines at any board to determine whether or not they are in use, and, secondly, of an arrangement of the annunciators and switches of the different lines by which special clearing-out annunciators are not required.

In the accompanying drawings, illustrating my invention, Figure 1 represents sectional views of sections of two multiple switchboards and the main-line central-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. Fig. 3 represents an operator's test system. Fig. 4 represents a subscriber's-station apparatus necessary to illustrate my invention.

I place as many switchboards in the central office as are found necessary or desirable in order to properly operate the exchange. In each board is a spring-jack switch for each line. At the board where the calls of a line are to be answered there is still another spring-jack switch for the line, to which the operator makes the connection of his cord system when he answers the subscriber's calls. This switch I designate as the "answering-switch" of the line. The answering-switches of the lines at any board are conveniently placed at the board where the operator may readily reach them with her cord apparatus. 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 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 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-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 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-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; *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. *a b* are the 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 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.

B′ B′ are test-batteries, one for each line and each connected into the circuit of the line, as will hereinafter be described.

Two metallic-circuit lines are shown in the

figures, 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 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 and to the answering-switch last. It then passes through the test-battery of the line, and is then connected to the other side or branch of the line to which the contact-pieces *j j* are connected. The annunciator of the line is placed in the circuit between the contact-piece *j* of the answering-switch and the contact-piece *j* of the switch immediately preceding the answering-switch and is located at the same board as said answering-switch. The answering-switches are marked *y y*. The two branches of the line may be 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 plugs. 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 the 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, and B is her calling-generator. 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 operator's calling-generator. 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 plugs 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 contact *o′* should be so placed that it will not make contact with *m* or *n* when the switch-levers are moved from their normal position. 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 and calling-generator. 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, and *t′* is the test receiving instrument, which may be any suitable instrument operating substantially as will be described. *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 connections 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 long enough so that she can connect any plug with any switch at her board.

In the subscriber's-station apparatus shown in Fig. 5, 1 is the telephone-switch. 2 is the calling-generator. 3 is the signal-receiving bell. 4 is the subscriber's telephone. 5 is the secondary, and 6 is the primary, of the induction-coil. 7 is the transmitter. 8 is the transmitter-battery. 9 is a condenser. 10 is a resistance-coil of suitable resistance. These parts may be of usual forms of apparatus and are connected as shown or in other ways so as to perform practically the operations required and the operations hereinafter described. The condenser and the resistance-coil are connected in the apparatus in multiple or parallel circuit to each other.

When the subscriber's telephone is on its switch, the signal-receiving bell is in the circuit of the line, and the telephone, the secondary of the induction-coil, and the condenser and resistance-coil in parallel circuit are shunted by a wire of small resistance, so as to be practically out of the circuit. When the telephone is off the switch, the telephone,

the secondary of the induction-coil, and the condenser, with the resistance-coil, are in the circuit and the signal-bell is practically out of the circuit.

The test receiving instruments and test-batteries should be so constructed and adjusted to each other and the circuits that the instrument will sound or respond when it and the battery is looped into the closed circuit of any single line and the subscriber's telephone is not off its switch for use and is therefore of comparatively low resistance, but will not respond if the circuit is open at any point or if the subscriber's telephone is off its switch and the condenser and resistance-coil at the subscriber's station is included in the circuit as described, and thereby the resistance of the line-circuit is considerably increased or the line is switched with another line and thereby has its test-circuit open, as will hereinafter be indicated.

The general features of the operation of the switch system as shown and described will be readily understood by those skilled in the art. When an operator receives a call on the calling-annunciator of any line, she places one plug of a pair of her switch-plugs in the answering-switch of the line (which is located at her board) and by conversation finds out what line is wanted. She then places the other plug of the pair in the switch of the line wanted at her board (but not into an answering switch) and by operating the looping-in switch of the pair of cords may call the subscriber wanted or may leave the two lines connected together for conversation, with neither her telephone nor calling-generator in the circuit. When the lines are thus left for conversation, the calling-annunciator of the line on which the call originated is in the circuit of the two lines and any clearing-out signal sent over the circuit will be received on it. The calling-annunciator of the other line is not included in the circuit and will not receive any clearing-out signal sent over the circuit. This system therefore provides clearing-out annunciators for the circuit of any two lines connected together for conversation 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, as pointed out, the combined circuit is one of metallic continuity throughout 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 in and cause the clearing-out signal to be indicated. This is obtained by the use of the resistance-coils at the subscribers' stations for the test system and the marginal adjustment for the same, as will be described, by which the tests are obtained. At the same time by means of the condensers shunting the resistance-coils at the subscribers' stations an easy passage of rapidly-alternating telephone-currents is obtained.

The operation of the test system is as follows: When an operator desires to test a line, she places her test-plug into the switch of the line, and by so doing disconnects the points *g* and *h* of the switch and connects them with the contact-pieces of the plug. If, then, the line is not switched at any board and the subscriber's telephone is on its switch, the test receiving instrument will sound or respond, indicating that the line is free to be switched to. If, however, the subscriber has taken his telephone from the switch for use, the instrument will not sound, as the condenser and resistance-coil in the circuit will prevent it from doing so because the resistance of the circuit is thereby increased. If, again, the line is switched at some board and the test is made in the cut-off portion of the line, the instrument will not sound because the test-circuit is open at the pair of contact-points of the switch used for switching. If, again, the line is switched at any board with another line and the test is made in some switch between the one used for switching and the subscriber's station, the instrument will not sound on account of the battery being cut off from the circuit in which the test receiving instrument is included. It will be seen that the test depends on the marginal adjustment of the test receiving instrument to the battery and circuits by which the instrument sounds when included in the normal circuit of a line, but does not sound when the resistance of the circuit in which it is included is considerably greater than the resistance of the line while in its normal condition. When a test of a line is made and the test receiving instrument sounds, the operator knows that neither the line is switched for use nor the subscriber's telephone is switched for use, and when the instrument does not sound she knows that either the subscriber's telephone is switched for use or the line is switched for use, and she will not connect the line with any other line. By this system a subscriber's line is reserved to himself from the time he takes down his telephone for use or the line is switched for use.

In multiple systems heretofore devised the line-annunciators have been placed in the circuit-wire which connects the two branches of the line, after one of the branches has passed through all the pairs of its switch contact-points and the other has been connected to the other contact-pieces of its switches on the several boards, and a special clearing-out annunciator has been required for each pair of switch-cords. In my system, by the employment of the answering-switches located in their respective circuits, as described, and the location of the line-annunciators in their respective circuits, as described, I provide for a single annunciator in

the circuit of each two lines connected together for conversation, which is located at the board where the connection between the two lines is made and which will indicate any clearing-out signal sent over the line, and at the same time I dispense with the use and the accompanying expense of special clearing-out annunciators for the several pairs of cords.

In some multiple systems the test indicates to the operator that the line was switched at some board of the exchange. In other systems the test indicates that the subscriber's telephone is switched for use.

In my system the test indicates that the line is busy whether it is switched at any board or the subscriber has taken his telephone down for use, and the service of the exchange is more satisfactory to the subscribers than in either of the other general systems of testing above indicated.

I claim as my invention—

1. In a telephone-exchange system, a metallic-circuit line one side or branch of which passes through a pair of switch contact-points and thence through a test-battery to the other side or branch of the line, in combination with switch apparatus by which when the two sides or branches of the line are connected through such switch with the two sides or branches of another metallic-circuit line said pair of contact-points is open, a condenser and resistance-coil in derived circuit at the subscriber's station and a switch with contact-points to switch the condenser and resistance-coil in derived circuit into the circuit of the line when the subscriber's telephone is switched for use, a test receiving instrument and switch apparatus by which the instrument may be included in the normal circuit of the line, said instrument and switch being so adjusted to each other and the line that the instrument sounds when included in the normal closed circuit of the line but does not sound when on open circuit with the battery or on closed circuit with the battery and the line with the condenser and resistance-coil in the line on the telephone being switched for use, substantially as set forth.

2. In a telephone-exchange system, multiple switchboards, metallic-circuit lines, one side or branch of each of which passes through a pair of switch contact-points and thence through a test-battery to the other side or branch of the line, in combination with switch apparatus by which when the two sides of the line are connected through such switch with the two sides or branches of another metallic-circuit line said pair of contact-points is open, a condenser and resistance-coil in derived circuit, at the subscriber's station and a switch with contact-points to switch the condenser and resistance-coil in derived circuit into the circuit of the line when the subscriber's telephone is switched for use, a test receiving instrument and switch apparatus by which the instrument may be included in the normal circuit of each line, said instrument and battery being so adjusted to each other and the line that the instrument sounds when included in the normal closed circuit of the line but does not sound when on open circuit with the battery or on closed circuit with the battery and the line with the condenser and resistance-coil in derived circuit in the line on the telephone being switched for use, substantially as set forth.

3. In a telephone-exchange system, multiple switchboards, metallic-circuit lines, switches for said lines, one switch for each line on each board, one side or branch of each line passing successively through pairs of contacts of the line-switches on the several boards and from the last contact-point through a test-battery to contact-pieces, one for each switch of the line, and to the other side or branch of the line, in combination with pairs of double or loop-switch plugs at each board, the two contact-pieces on one plug being connected by flexible conductors to the two contact-pieces of its mate, adapted to be inserted into the switches and when a plug is inserted into a switch to disconnect the pair of contact-points and connect one of the contact-pieces of the switch-plug with that contact-point which is connected with said first-mentioned side or branch of the line, while the other contact-piece of the plug forms connection with said contact-piece of the switch, test receiving instruments, one at each board, each connected on its two sides to the two contact-pieces of a loop test-plug adapted to be inserted into any switch at its board, and when inserted to disconnect the pair of contact-points of the switch and form connection between them and its two contact-pieces, a condenser and resistance-coil in derived circuit at each subscriber's station and switches with contact-points to switch the condenser and resistance-coil in derived circuit into the circuit of the line when its subscriber's telephone is switched for use, said instruments and batteries being so adjusted to each other and the lines that an instrument sounds when included in the normal closed circuit of a line but does not sound when on open circuit with the battery or on closed circuit with the line and its battery with the condenser and resistance-coil in derived circuit in the line on the telephone being switched for use.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
B. WASHINGTON MILLER,
C. M. BROOKE.