(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCHBOARD.

No. 592,404. Patented Oct. 26, 1897.

Fig. 1.

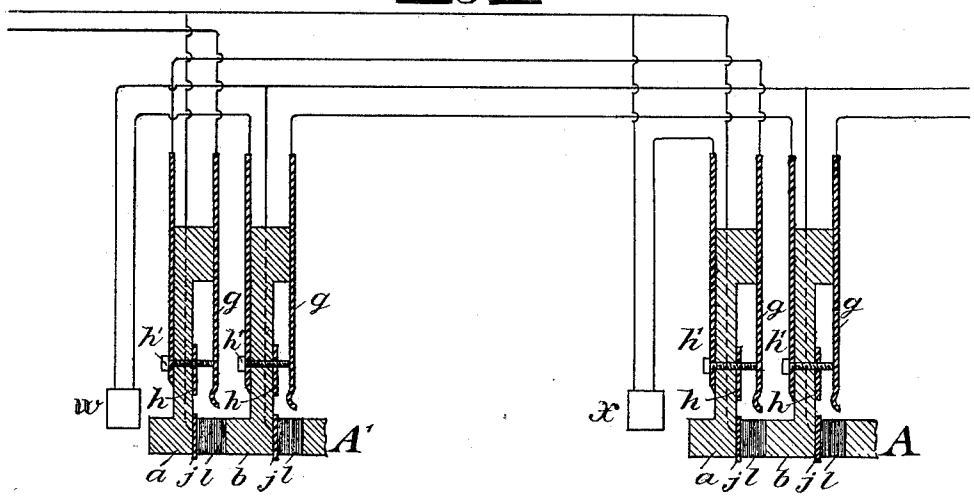


Fig. 2.

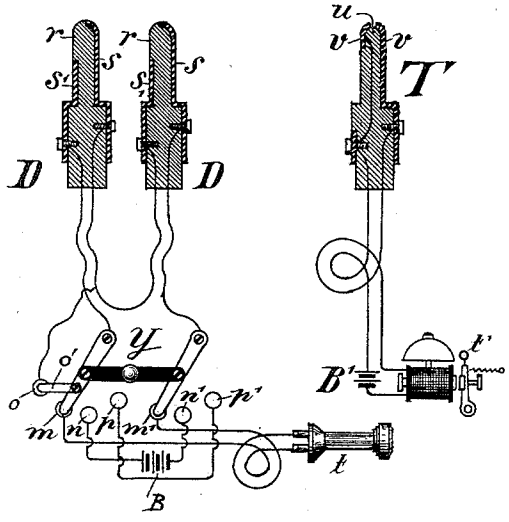
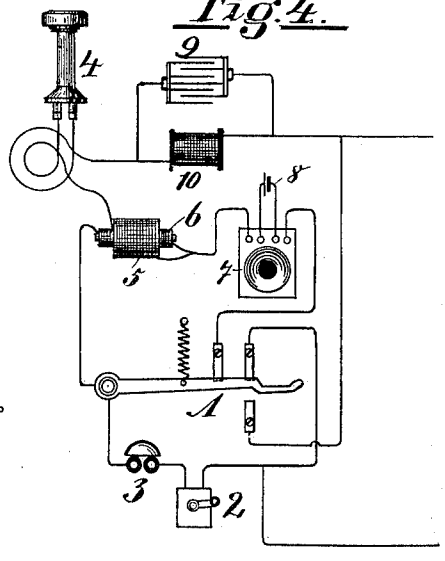


Fig. 3.

Fig. 4.



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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,404, dated October 26, 1897.

Application filed May 19, 1891. Serial No. 393,275. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, a citizen of the United States, residing at 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.

It consists of a system of testing the lines at any board to determine whether or not they are in use.

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 switchboards. Fig. 2 represents a diagram of an operator's cord system and apparatus to be used with the boards. 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. On 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 the 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 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.

Two metallic-circuit lines are shown in the drawings, 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 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 two sides or branches of the line.

The two branches of the line are 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 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-piece 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. *c* is the clearing-out annunciator. *t* is the operator's telephone, and B is her calling-generator.

The connections of the different parts are substantially as shown.

The looping-in switch has two levers and three pairs of contact-points on which the levers may alternately be 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 loop which contains the clearing-out annunciator. When the levers pass from *m m'* to *p p'*, they rest on *n n'*.

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.

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 the 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 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 and battery.

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. 4, 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 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 resistance-coil and condenser in multiple or 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 and resistance-coil, connected as described, 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 are looped into the closed circuit of any single line and the subscriber's telephone is not off its switch for use, 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, and the resistance of the circuit is thereby increased or the line is switched with another line and thereby has its test-circuit open or the resistance increased, as will hereinafter be indicated. The test system therefore depends on a marginal construction of the test receiving instruments and batteries to the circuits and apparatus by which the test receiving instrument sounds when on closed circuit in the normal and low resistance closed circuit of each line, but does not sound when in a closed circuit which contains considerably greater resistance, although current is then passing through the instrument. This construction and marginal adjustment depend on the fact that an electromagnet may be readily made

so as to operate when a battery and a certain resistance is 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 simple circuit of any line of the exchange, but will not be actuated when the additional resistance is introduced. The resistance may be such as is necessary or desirable in order to obtain such a marginal adjustment of the parts of the exchange system.

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 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 subscriber's 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, on account of the small resistance with which it is included, thus 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 increase greatly the resistance of the circuit, and thus prevents it from doing so. If, again, the line is switched at some board and the test is made in the cut-off portion of the line—that is, that portion which is between the switch used for switching and the office ground—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 condenser and resistance-coil being in the circuit in which the test receiving instrument is included, thus increasing the resistance of the circuit, or if the subscriber's telephone is not switched for use, on account of the increased resistance due to both lines being connected together.

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.

By this system an all-metallic circuit is provided through the resistance-coils at the subscribers' stations for the clearing-out current, while at the same time the condensers at the subscribers' stations furnish a ready path for the rapidly-alternating telephone-currents. Of course the annunciators should be such that they are not operated by the test-batteries when brought into closed circuit with them, and for this purpose suitably constructed and connected polarized annunciators may be used.

In multiple-switchboard systems an operator to whom certain lines are assigned to answer frequently receives several calls at practically the same moment, and it may require some time before she can switch to a certain line and answer its call. In systems in which the test depends only on the line being switched at some board another operator may in the meantime test the line, and finding it to test "free" may switch it with another line and cause annoyance and confusion to the subscriber. This cannot occur in this system of testing, because as soon as the subscriber takes his telephone from its switch the line will test "busy" whether or not it is switched at the central office. Again, in systems of testing which depend only on the subscriber's telephone being on or off its switch confusion frequently arises from the fact that a subscriber places his telephone on its switch when he is through conversation without sending in clearing-out signal and his line tests "free" and is "connected to" when it is already switched with another line. Lines in this condition are technically called "tied up." This, again, cannot occur in this system, because the line will test "busy" until it is disconnected at the central office whether or not the subscriber's telephone is on its switch. The system therefore combines the advantages and obviates the disadvantages of the two general systems of testing outlined above.

I claim as my invention—

1. In a telephone-exchange system, metal-

lic-circuit lines each normally on closed circuit, in combination with switch apparatus by which each line may be switched with any other line, a condenser and resistance-coil in derived circuit at each subscriber's station and a switch with contacts 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 battery in a loop and switch apparatus by which said loop may be switched into the normal circuit of the line, said instrument and battery being so adjusted to each other and each line by the marginal adjustment to the resistances that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively low resistance but does not sound when on open circuit, or on closed circuit with the line with the condenser and resistance-coil in derived circuit in the line-circuit, or on closed circuit with the line and another line, thereby increasing the resistance in circuit with the test receiving instrument and battery, substantially as set forth.

2. In a telephone-exchange system, multiple switchboards, metallic-circuit lines each normally on closed circuit, in combination with switch apparatus by which each line may be switched with any other line, a condenser and resistance-coil in derived circuit at each subscriber's station and a switch with contacts 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 battery in a loop and switch apparatus by which said loop may be switched into the normal circuit of the line, said instrument and battery being so adjusted to each other and each line by the marginal adjustment to the resistances that the instrument sounds when they are included in the normal closed circuit of the line, with its comparatively low resistance but does not sound when on open circuit, or on closed circuit with the line with the condenser and resistance-coil in derived circuit in the line-circuit, or on closed circuit with the line and another line, thereby increasing the resistance in circuit with the test receiving instrument and battery, substantially as set forth.

3. In a telephone-exchange system, metallic-circuit lines one side or branch of each of which passes through its pair of switch contact-points to the other side or branch of the line, in combination with switch apparatus by which when the two sides of a 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 clearing-out annunciator in the circuit of two lines when they are switched together for conversation, a condenser and resistance-coil in derived circuit at each subscriber's station and a switch with contacts to switch the condenser and resistance-coil into the line-circuit when the subscriber's telephone is switched for use, thereby increasing the resistance in circuit with the test receiving instrument and battery, a test receiving instrument and battery in a loop and switch apparatus by which said loop may be switched into the normal circuit of the line, said instrument and battery being so adjusted to each other and each line by the marginal adjustment to the resistance that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively low resistance but does not sound when on open circuit, or on closed circuit with the line with the condenser and resistance-coil in derived circuit in the line-circuit, or on closed circuit with the line and another line, thereby increasing the resistance in circuit with the test receiving instrument and battery, substantially as set forth.

4. In a telephone-exchange system, multiple switchboards and metallic-circuit lines one side or branch of each of which passes through a pair of switch contact-points 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 any other metallic-circuit line said pair of contact-points is open, a clearing-out annunciator in the circuit of two lines when they are switched together for conversation, a condenser and resistance-coil in derived circuit at each subscriber's station and a switch with contacts to switch the condenser and resistance-coil in derived circuit into the line-circuit when the subscriber's telephone is switched for use, a test receiving instrument and battery in a loop and switch apparatus by which said loop may be switched into the normal circuit of the line, said instrument and battery being so adjusted to each other and each line by the marginal adjustment to the resistances that the instrument sounds when they are included in the normal closed circuit of the line with its comparatively low resistance but does not sound when on open circuit, or on closed circuit with the line with the condenser and resistance-coil in derived circuit in the line-circuit, or on closed circuit with the line and another line, thereby increasing the resistance in circuit with the test receiving instrument and battery, substantially as set forth.

In testimony whereof I have hereunto subscribed my name.

MILO G. KELLOGG.

Witnesses:
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