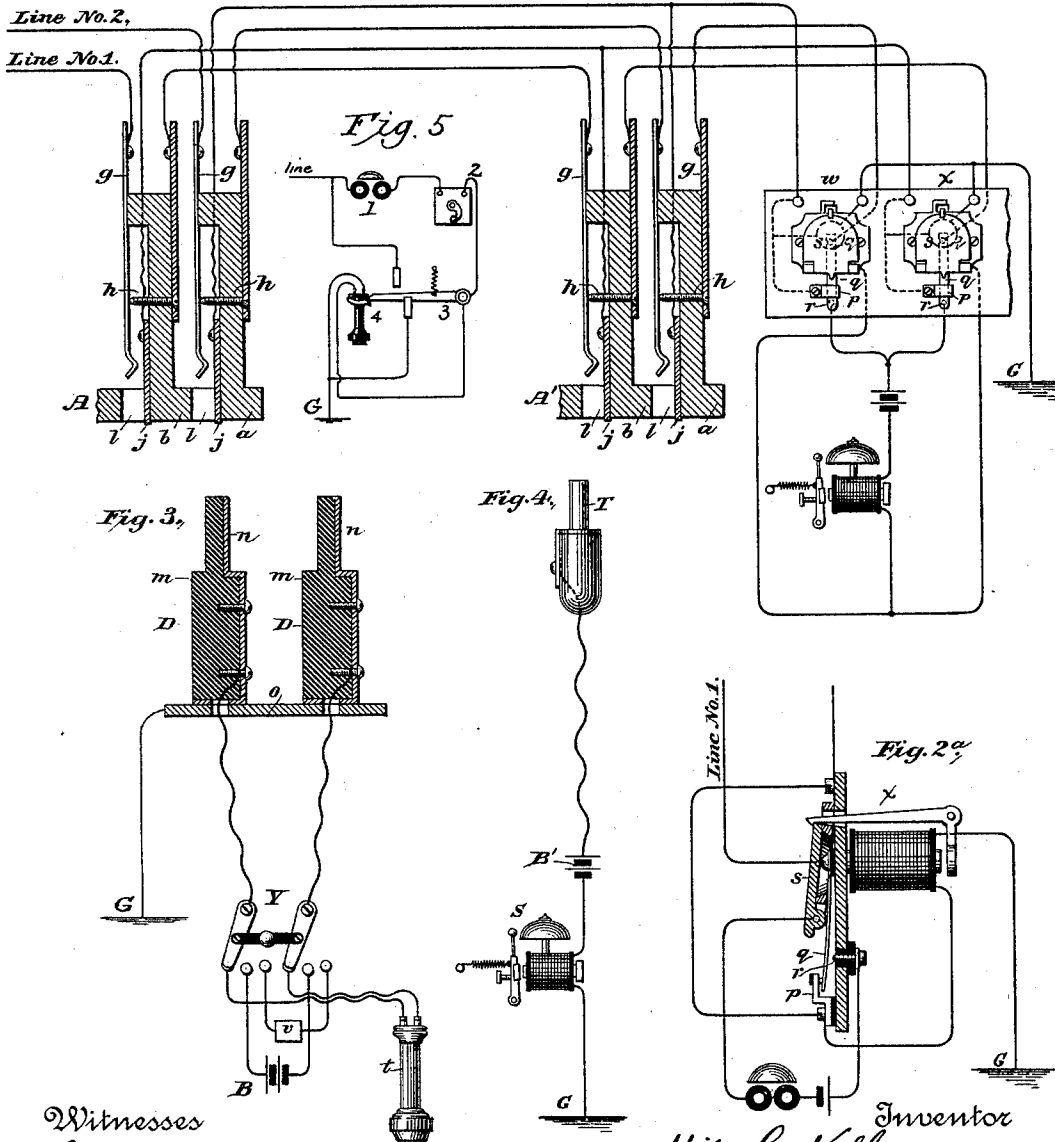
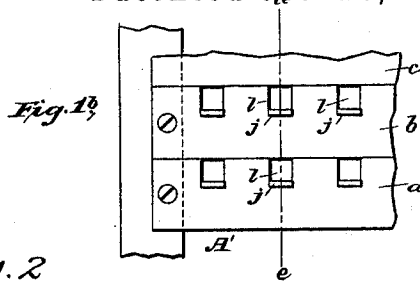
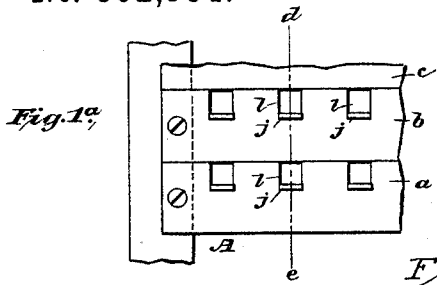


(No Model.)

M. G. KELLOGG.
MULTIPLE SWITCHBOARD.

No. 592,334.

Patented Oct. 26, 1897.



Witnesses
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UNITED STATES PATENT OFFICE.

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MULTIPLE SWITCHBOARD.

SPECIFICATION forming part of Letters Patent No. 592,334, dated October 26, 1897.

Application filed December 12, 1889. Serial No. 333,537. (No model.)

To all whom it may concern:

Be it known that I, MILO G. KELLOGG, of Chicago, Illinois, temporarily residing at Stuttgart, in the Empire of Germany, 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 made to the accompanying drawings, forming a part of this specification.

My invention relates to lines which are normally grounded at the central office.

It consists, first, of an improved system of subscribers calling on such lines; secondly, to an improved system of testing such lines, and, thirdly, to an improved night-signal at the central office.

In the accompanying drawings, illustrating my invention, Figures 1^a and 1^b are front views of sections of two multiple switchboards to which the same lines are connected. Fig. 2 is a diagram illustrating the main-line-switchboard apparatus and connections. Fig. 2^a is a detail view showing one of the line-annunciators and its circuit connections. Fig. 3 is an operator's cord system to be used with the boards. Fig. 4 is an operator's test system for testing at the boards. Fig. 5 is a diagram showing a subscriber's station apparatus that may be employed.

In the drawings like parts and apparatus are indicated by the same letters and figures of reference.

G in each case represents a ground connection.

In Fig. 2, A is a sectional view of the switchboard shown in Fig. 1^a, and A' is a sectional view of the switchboard shown in Fig. 1^b, each as indicated by the line *d e*. There are as many boards in the exchange as are necessary for the number of lines. On each board is a spring-jack or similar switch for each line. Each switch has a spring-contact which normally bears on an insulated contact-point and has a contact-piece insulated from the rest (except by the circuit connections) and is adapted to receive a switch-plug and, when a plug is inserted, to disconnect the spring from the contact-point and form connection between the spring and the contact-piece of the plug. *g g* represent springs of the differ-

ent switches, *h h* the contact-points, and *j j* the contact-pieces. *l l* are the switch-holes. *a b* are rubber strips on which the metal parts are mounted, as shown, and through the fronts of which are the holes *l l*. These holes are adapted to receive the switch-plugs shown in Fig. 3 and, when a plug is inserted, to operate the switch, as above described.

The contact-pieces *j j* should be so placed that a test-plug may be readily applied to them. Their function is to form test-pieces for their lines on the different boards, and they may be placed as shown or in other convenient positions on the boards.

w and *x* are line-annunciators, one for each line shown. Each annunciator has a pair of contact-points which are in electrical contact when the annunciator does not indicate a call and which are open to each other while the drop is down and the annunciator indicates a call.

Each annunciator has a contact-spring *q* and a drop *s* normally out of contact and connection with the spring. It has also a contact-point *p* with which the spring is normally in contact and another contact-point *r* with which the spring is normally out of contact. When the annunciator indicates a call, the drop falls and the lower projection of the drop comes into contact with the spring *q* and forces the spring out of contact with *p* and into contact with *r*. When, therefore, the drop falls to indicate a call, it opens one pair of contacts, that between *p* and *q*, and closes two pairs of contacts, that between *s* and *q* and that between *q* and *r*.

The connections of the lines to the switchboards and apparatus are as follows and as shown for line No. 1 and line No. 2: The line passes successively through the pair of contact-points of its switches on the several boards, passing in each case to the spring first. It then passes to the spring-contact *q*, thence to contact-piece *p*, and thence through the annunciator-magnet to the ground. The contact-pieces *j j* of a line are connected to the circuit of the line, the connection being between the contact-points *p q* and the annunciator-magnet. The annunciator-magnet in addition to its function as a magnet furnishes a resistance which is utilized in the testing,

as hereinafter described. If additional resistance is required in order to produce the adjustment for testing described hereinafter, it may be placed in the circuit with the annunciator, or resistance may be placed instead of the annunciator-magnet.

Fig. 3 shows an operator's cord system with one pair of cords and their plugs, switch, and annunciator, and the operator's telephone and calling generator or battery. The plugs *DD* are constructed substantially as shown, *mm* being the insulators and *nn* the contact-pieces, and they should be inserted into the switches in such a position that the contact-piece of the plug is in connection with the spring and is not in connection with the contact-piece *j*. *o* is a metal strip on which the bases of the plugs normally bear and which then connects their contact-pieces with the ground. The circuits are as shown. The method of connecting other pairs of cords with their apparatus to the system, as well as the method of operating the system in connection with the boards, will be apparent to those skilled in the art. Each operator has a cord system and as many pairs of cords as she may need, and they are conveniently placed and mounted at her board.

Fig. 5 shows a subscriber's-station apparatus which may be used in the system. 1 is the signal-receiving bell; 2, the calling-generator; 3, the telephone-switch, and 4 the subscriber's telephone. When the telephone is in its normal position on the switch, as shown, the bell and generator are in the direct circuit of the line, and when the generator is operated and the line-circuit is complete current will pass over the line, which will operate the line-annunciator and the bell, as hereinafter indicated.

In the operator's test system shown in Fig. 4, *T* is the test-plug. *S* is the test receiving instrument. *B'* is the battery, and *G* is the ground connection. They are connected as shown, and each operator has one test system suitably arranged and mounted for her work.

The instrument and battery are adjusted to the other parts and the line-circuits as follows: They are of such strength that when closed to the circuit of a line through its contact-piece *j*, and the circuit to the subscriber's ground through the pair of contact-points of the switches and the pair of contact-points to the annunciator, and the circuit to the office ground through the line-annunciator are not open, the instrument will sound or respond, indicating that the line is "free," and that when said circuits are open, either at any pair of switch contact-points or at the pair of annunciator-points, the instrument will not sound, indicating that the line is in use, either by its being switched at some board or by its annunciator indicating a call. The operator therefore knows that the line is in such use and is "busy" and will not switch it to another line.

The adjustment above described is easy to

accomplish and depends on the fact that an electromagnet having an armature may easily be constructed so as to attract and move the armature when a battery is placed in closed circuit through it and a certain resistance, but will not move the armature when the resistance is considerably increased. This adjustment depends on the style and resistance of the electromagnet, the strength of the retractile spring of the armature, the size of the battery, and the resistances used. For instance, the resistance of the lines may be about two hundred and fifty ohms each and the resistance of the annunciator-magnets may be about two hundred and fifty ohms each, and the bell and battery may be such that when they are included in closed circuit with, say, about one hundred and twenty-five ohms resistance, the bell will sound, but when the resistance is about two hundred and fifty ohms the bell will not sound. An ordinary electric bell with about one hundred ohms resistance and a suitable retractile spring and, say, eight or ten cells of battery may be thus adjusted to operate. When under such adjustment and conditions as to resistance of the lines and annunciators the test-plug *T* is applied to a contact-piece *j* of a line and neither the line is switched at any board nor its annunciator indicates a call, there is a circuit from the plug to both the office ground through the annunciator-magnet and to the subscriber's ground through the annunciator and switch-points. The resistance of the joint circuit will be, say, one hundred and twenty-five ohms, and the bell will sound. If, however, the line is switched at any board or its annunciator indicates a call, the circuit to the subscriber's ground will be open, and the circuit in which the bell and battery are included is that to the office ground, which is about two hundred and fifty ohms. The bell will not then sound. When the bell sounds, the operator therefore knows that neither the line is switched nor the annunciator indicates a call, and when it does not sound she knows that either the line is switched or the annunciator indicates a call.

This system of testing differs from other systems in that the line tests "busy," whether it is switched or whether its annunciator indicates a call, and it is applicable in its general features to all systems of testing in which the test is made directly to the circuit of the line whether the line is switched or not and in which the test indicates whether or not the connection of the line is broken to the office ground.

The night-signal system or arrangement is as follows: There is a night bell or battery for all the lines of the exchange or for a group of lines, as preferred. One side of the circuit connection which contains the bell and battery is connected to all the contacts *r* of the line-annunciators. The other side of the connection is connected with all of the drops *s* of the line. There is therefore a local circuit

for each annunciator which contains the bell and battery and is normally open at two points, that between the drop *s* and spring *q* and that between the spring *q* and contact-point *r*. When the drop falls, it closes as heretofore indicated, these two open points, and the bell and battery being thus placed in a closed circuit the bell will ring.

The current of a subscriber's generator being a comparatively strong one and generally one rapidly intermittent frequently causes induction on neighboring wires, which impedes telephone conversation on them as long as the subscriber may think it necessary or find it convenient to operate his generator in making a call when the lines remain on closed circuits. In this system the circuit is open as soon as a call is indicated, so that further operation of the generator will not cause prolonged induction on neighboring wires. At the same time the subscriber's own signal-bell will stop ringing as soon as his annunciator at the central office indicates a call, and he thereby knows that his call has been indicated. It is therefore practically an automatic return-signal that his call has been indicated.

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

1. A test-circuit for a subscriber's line, from the office ground through a test receiving instrument and battery to a test-plug and thence to a line-contact when the test is applied, thence in one direction to the office ground through a resistance and in the other direction to the subscriber's ground through a pair of switch contact-points in the central office normally closed but open while the line is switched by the switch which controls them and through a pair of annunciator contact-points normally closed but open while the annunciator indicates a call, said instrument being so adjusted to the battery and circuits that it will sound when on a test being made neither the line is switched for use, nor the annunciator indicates a call, but not otherwise, substantially as set forth.

2. A test-circuit for a subscriber's line, from the office ground through a test receiving instrument and battery to a test-plug and thence to a line-contact when the test is applied, thence in one direction to the office ground through a resistance and in the other direction to the outer ground of the line, through a pair of annunciator contact-points normally closed but open while the line-annunciator indicates a call and through a series of pairs of switch contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched at its board, said instrument being so adjusted to the battery and the circuits that it will sound when on a test being made neither the line is switched for use nor the annunciator indicates a call but not otherwise, substantially as set forth.

3. A pair of switch contact-points normally

closed but open while the line is switched by the switch which controls them, a pair of annunciator contact-points normally closed but open while the line-annunciator indicates a call, and a resistance in combination with a telephone-line grounded at its outer end and passing, successively, through said pair of switch contact-points, said pair of annunciator contact-points and said resistance to the ground, and a test wire or circuit containing a test receiving instrument and battery, grounded on one end and connected on its other end to a test plug or device adapted to be brought into connection with the circuit of the line between said resistance on the one hand and said pairs of switch and annunciator contact-points on the other hand, substantially as set forth.

4. Pairs of switch contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched at their board, a pair of annunciator contact-points normally closed but open while the line-annunciator indicates a call, and a resistance, in combination with a telephone-line grounded at its outer end and passing, successively, through said pairs of switch contact-points, said pair of annunciator contact-points and said resistance to the ground, and a test wire or circuit, grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into connection with the line-circuit between said resistance on the one hand and said switch and annunciator contact-points on the other hand, said instrument being so adjusted to the battery and circuits that on a test being made it will sound when neither the line is switched nor the annunciator indicates a call but not otherwise, substantially as set forth.

5. A series of pairs of switch contact-points, one pair on each of several boards, each pair normally closed but open while the line is switched at their board, a pair of annunciator contact-points normally closed but open while the annunciator indicates a call and a resistance, in combination with a telephone-line passing, successively, through said switch and annunciator contact-points and said resistance, and a test wire or circuit containing a test receiving instrument and battery and connected at one end to a test plug or device adapted to be brought for testing into connection with the line-circuit between said switch and annunciator contact-points on the one hand and said resistance on the other hand, said instrument being so adjusted to the battery and circuits that it will sound when on a test being made neither the line is switched for use nor the annunciator indicates a call but not otherwise, substantially as set forth.

6. In a telephone-exchange system, a subscriber's line grounded at its outer end, at the central office a switch with a pair of contact-points normally closed but open while the line is switched by it, and an annunciator

containing a pair of contact-points normally closed but open while the annunciator indicates a call, said line passing, successively, through said pair of switch contact-points, 5
thence through said pair of annunciator contact-points and thence to the ground through the annunciator-magnet, in combination with a test contact-piece connected to the circuit between said annunciator contact-points and 10
said annunciator-magnet, and a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into 15
connection with said contact-piece, said instrument being so adjusted to the battery and circuits that it will sound when on a test being made neither the line is switched nor the annunciator indicates a call, but not otherwise, 20
substantially as set forth.

7. In a telephone-exchange system, a subscriber's line grounded at its outer end, at the central office a pair of switch contact-points normally closed but open while the line is 25
switched by the switch which controls them, a pair of annunciator contact-points normally closed but open while the line-annunciator indicates a call, and a resistance, said line passing, successively, through said switch 30
and annunciator contact-points and thence through said resistance to ground, in combination with a test contact-piece connected to the circuit between said resistance on the one hand and the switch and annunciator contact-points on the other hand, and a test wire or 35
circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to a test plug or device adapted to be brought for testing into connection with said contact-piece, said instrument being so adjusted to the battery and line that it will sound when on the test being applied neither the line is switched for use nor the annunciator indicates a call but 40
not otherwise, substantially as set forth.

8. In a telephone-exchange system, a subscriber's line grounded at its outer end and at the central office a series of pairs of switch contact-points, one pair on each of several 50
boards and each pair normally closed but open while the line is switched at its board, a pair of annunciator contact-points normally closed but open while the line-annunciator indicates a call, and a resistance, said line 55
passing, successively, through said pairs of switch and annunciator contact-points and thence through said resistance to the ground, in combination with a test contact-piece connected to the circuit between said resistance on the one hand and said pairs of switch and annunciator contact-points on the other hand, and a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to 60
a test plug or device adapted to be brought for testing into connection with said contact-piece, said instrument being so adjusted to

the battery and circuits that it will sound when on the test being applied neither the line is switched for use nor the annunciator 70
indicates a call but not otherwise, substantially as set forth.

9. In a telephone-exchange system, a subscriber's line grounded at its outer end and normally passing to ground at the central 75
office through a pair of annunciator contact-points normally closed but open while the line-annunciator indicates a call and a resistance in combination with switching devices at the central office to disconnect the 80
line from said annunciator contact-points and resistance while the line is switched for use, and a test wire or circuit containing a test receiving instrument and battery, grounded at one end and connected at its other end to 85
a test plug or device adapted to be brought for testing into connection with the circuit of the line between said resistance and said annunciator contact-points, said instrument being so adjusted to the battery and circuits 90
that it will sound when on a test being made neither the line is switched for use nor the annunciator indicates a call, but not otherwise, substantially as set forth.

10. In a telephone-exchange system, multiple switchboards and telephone-lines connected to the same, each line normally passing through a pair of contact-points normally closed but open while its annunciator indicates a call and thence through a resistance 100
to the ground, in combination with switching devices at the central office to disconnect a line from its annunciator contact-points and resistance while it is switched for use, and test wires or circuits, one for each board, each 105
containing a test receiving instrument and grounded on one side and connected on its other side to a test plug or device adapted to be brought for testing into connection with the circuit of the line between said resistance 110
and said pair of annunciator contact-points, said instrument being so adjusted to a battery in the normally open test-circuit and to the circuits that it will sound when on a test being made neither the line is switched for use 115
nor the annunciator indicates a call, but not otherwise, substantially as set forth.

11. In a telephone-exchange system, a contact-spring normally in contact with one contact-point and open to another contact-point, 120
and an annunciator-drop normally insulated from said spring and which comes into connection with it and presses it away from its normal contact with said first-mentioned point and into contact with said second-mentioned point when it indicates a call, in combination with the line-circuit of the annunciator normally passing through said spring and first-mentioned point and a local circuit the two ends of which terminate in said second-mentioned point and said drop, respectively, 130
substantially as set forth.

12. In a telephone-annunciator, the combination of a contact-spring normally in con-

tact with one contact-point and open to another contact-point and an annunciator-drop normally insulated from said spring and coming into electrical connection with said spring on falling to indicate a call and at the same time pressing said spring away from its normal contact with said first-mentioned point

and into electrical connection with said second-mentioned point, substantially as set forth.

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