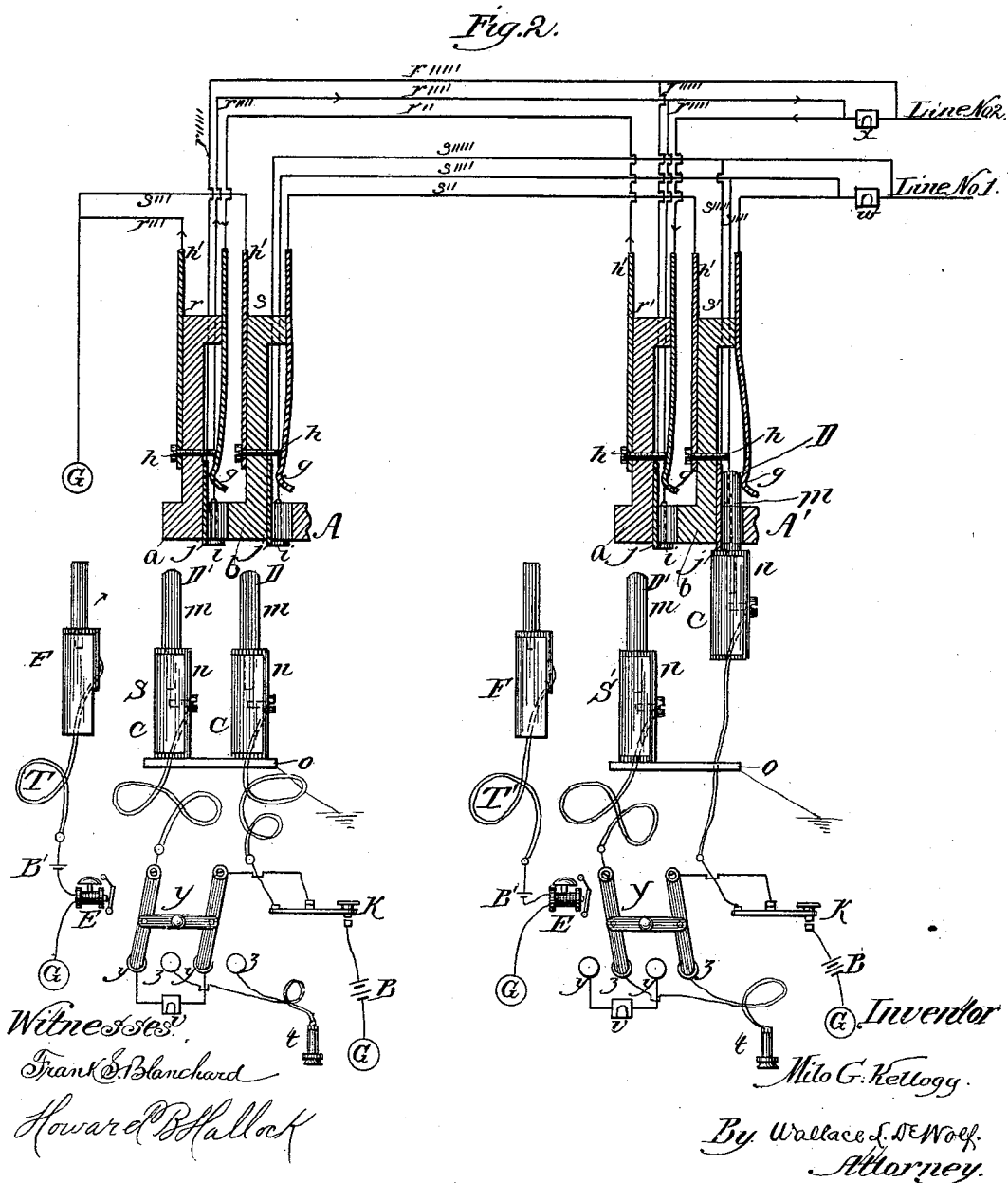
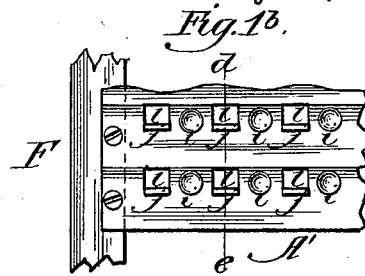
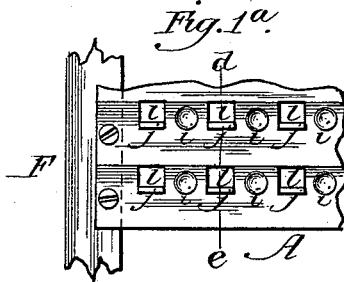


(No Model.)

M. G. KELLOGG.  
MULTIPLE SWITCH BOARD.

No. 385,863.

Patented July 10, 1888.



# UNITED STATES PATENT OFFICE.

MILO G. KELLOGG, OF HYDE PARK, ILLINOIS.

## MULTIPLE SWITCH-BOARD.

SPECIFICATION forming part of Letters Patent No. 385,863, dated July 10, 1888.

Application filed April 25, 1887. Serial No. 235,955. (No model.)

*To all whom it may concern:*

Be it known that I, MILO G. KELLOGG, of Hyde Park, Illinois, have invented certain new and useful Improvements in Multiple Switch-Boards 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 especially to a telephone-exchange system in which the subscribers' lines are grounded at the central office.

It consists, first, of a multiple switch-board system of operating an exchange and testing at any board to determine whether any given line is in use, which system I shall hereinafter describe and claim in detail.

It consists, secondly, of an operator's system of cords, apparatus, and circuits for answering, calling, switching, and clearing out subscribers' lines, which system I shall hereinafter describe and claim in detail, said system being applicable to said multiple switch-board system mentioned above and to other systems of telephone-exchange switch-boards.

In my multiple switch-board system I place as many switch-boards in the central office as are found necessary, in order to answer the calls and connect and disconnect the subscribers' lines. On each board I place for each telephone-line which centers at the office a spring-jack or similar switch having three insulated contact-points, two of which are normally in contact, said switch being adapted to receive a plug, and when the plug is inserted to disconnect the points which are normally in contact and connect one of them and the other contact-point to the metal piece of the plug, to which is attached a flexible conducting-cord, and when the plug is withdrawn to again connect the contact-points which are normally in contact and disconnect those which are in contact while the plug is inserted. The switches of a line on the different boards may be called a series of switches. I place near each switch an insulated contact-piece, which I use as a test-bolt of its line. These test pieces or bolts on the different boards belonging to a given line may be called a series of test pieces or bolts.

Figures 1<sup>a</sup> and 1<sup>b</sup> of the drawings are front views of sections of two multiple switch-boards

to which the same wires are connected. Fig. 2 shows a complete diagram of the boards with their connections and all the central-office apparatus, circuits, and connections necessary to operate them according to my invention.

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

In Fig 2, A is a sectional view of the switch-board shown in Fig. 1<sup>a</sup>, as indicated by line *d e*; and A' is a sectional view of the switch-board shown in Fig. 1<sup>b</sup>, as indicated by line *d e*.

*a b* represent rubber strips on which the metal parts of the spring-jack switches are mounted. These strips may be long enough to receive any convenient number of spring-jack parts.

*l l*, &c., are square holes through the fronts and at the edges of the strips adapted to receive the switch-plugs.

The contact-springs *g g*, &c., are mounted to the rear of and are parallel to the holes *l l*, &c., to which they belong, as shown. The contact-points *h h*, &c., on which the contact-springs or spring-levers normally bear, pass through the strips, and have connecting-pieces *h' h'*, as shown. The contact-pieces *j j* of the switches are placed on one of the faces of their respective switch-holes, as shown. The switch-plugs are substantially as shown, and as will hereinafter be described.

The several parts mentioned above are so made, shaped, arranged, and adjusted that when a plug is inserted into any of the holes it raises the spring-lever in the rear of the hole from the contact-point on which it normally bears, and the metal piece of the plug is connected to the spring-lever and also to the contact-piece *j*.

Each section of a rubber strip, with its spring-lever, contact-point and contact-piece, and the hole, all arranged and operating as above, may be called a "spring-jack switch." The rubber strips are placed one above the other, as shown. The lower edge of one strip therefore provides the upper edges of the holes in the strip which is below it. It is not necessary that the holes should be actually square. They may be of any shape adapted to the shapes and arrangement of the parts used.

*i i* are the test-bolts mentioned above. Each test-bolt is placed to the right of the spring-jack switch of the line to which it belongs.

It may, however, be placed in any other convenient place, providing it is so marked or placed that it may readily be known to what line it belongs.

5 Two subscribers' lines are shown in the drawings. They are marked line No. 1 and line No. 2.  $ss'$  are the switches of line No. 1 on the two boards shown, and  $rr'$  are the switches of line No. 2 on the two boards shown. They  
10 may be single-circuit wires grounded at the subscribers' stations, and they pass through their series of switch-points  $gh$  on the different boards, and to ground, passing first to the lever  $g$  of a switch, all in the usual manner, and as shown. The other wires of the exchange would be connected to their switches in like manner. Other boards might be added to the exchange, and the circuit of the lines through their respective series of switches on the different boards would be similar to the above, and such as is usual.

$w$  and  $x$  are calling-annunciators. There may be one for each line, and they may be distributed on the several boards, so that the  
25 operators may conveniently answer the calls of the exchange. The annunciator  $w$  is for line No. 1 and  $x$  is for line No. 2. Each annunciator is placed in the circuit of its line after the line enters the office and before it goes to any pair of switch-points,  $gh$ , of any of its series of switches. From each line, after it enters the office and before it goes to its annunciator, I branch a wire or wires to each of the contact-pieces  $jj$  of its series of switches.  
35 Wire  $s''''$  and its branches thus connect line No. 1 with contact-pieces  $jj$  of switches  $s$  and  $s'$ , and wire  $r''''$  and its branches thus connect line No. 2 with contact-pieces  $jj$  of switches  $r$  and  $r'$ . From each line, after it enters the office and before it is connected to any of the contact-springs  $g$  of its switches, and preferably from a point between the annunciator and the springs, I branch a wire or wires to each bolt of its series of test-bolts  $ii$ , as shown.  
45  $s''''$  and its branches thus connect line No. 1 to its test-bolts  $ii$ , and  $r''''$  and its branches thus connect line No. 2 to its test-bolts  $ii$ .

$SS'$  in Fig. 2 are operator's systems of cords with plugs, keys, switches, clearing-out annunciators, operator's telephone, calling-generator, and circuits. One system is shown at each board, and is intended for one operator. Only one pair of cords, with its plugs, key, switch, and clearing-out annunciator, is shown in each system. Others could be added in a manner which will be apparent to those skilled in the art.

$DD'$  are the two switch-plugs connected to the pair of cords.

60  $mm$  are the metal pieces of the plugs adapted when the plug is inserted in the switch to separate the spring-lever  $g$  from the contact-point  $h$  of the switch and form connection with the lever  $g$  and contact-piece  $j$ .

65  $CC$  are the rubber handles of the plugs.

$nn$  are connecting-pieces, as shown.

$o$  is a metal piece connected to the ground,

and on which the plugs normally rest, as shown, and by which the cords are normally connected to the ground. Weights, in the  
70 usual manner, or other similar devices may be used to bring the pieces  $n$  on piece  $o$  and establish a good connection.

$Y$  is a looping-in switch.

$yy$  and  $zz$  are contact-bolts of the switch,  
75 on which the operator may at will place the pair of switch-levers.

$k$  is a calling-key, constructed, connected, and operating as shown. A switch or similar device might be used in its place.

$v$  is a clearing-out annunciator.

$B$  is the operator's signaling-generator, and  $t$  is her telephone. She needs only one generator and telephone for her cord system.

The circuits are substantially as shown.

85  $T$   $T'$  are operator's test systems. One system is shown at each board, and is intended for one operator. Each system consists of a flexible conductor with a plug or testing device at one end and grounded at the other end by means of a conducting-wire, and a signal bell or device and an electric battery or generator in the circuit between the plug and the ground.

$F$  is the test plug or device, and is so constructed that the operator can readily bring it into contact with any contact-piece or test-bolt  $i$  at her board.

$B'$  is the test-battery, and  $E$  is the electric bell. The battery and bell should be so adjusted to each other that the bell will ring when the test-circuit described above is closed through a circuit of small resistance—as, for instance, that from any test-bolt  $i$  through the connections of its line on and between the different boards and to ground, but will not ring when the test circuit or system is closed through a considerably larger resistance—as, for instance, that of a subscriber's line and his signal-bell, telephone, and ground, or that of a joint conductor, the branches of which are two subscribers' lines connected together and passing through their telephones or signal-bells and to ground.

The different parts of an operator's cord system and her test system should be placed in convenient arrangement at the board which she attends, so that she can conveniently operate the exchange system. The cords should be long enough to reach any of the switches at the boards.

It is evident that when one switch-plug of a pair is inserted, as described, into any spring-jack switch of a line the line is opened at the contact-points  $gh$  of the switch and is disconnected from the ground, and the flexible cord attached to the plug is connected to the line both through the spring-lever  $g$  and the contact-piece  $j$  and their connecting-wires. It is also evident that when this connection is made the calling-annunciator of the line is shunted or short-circuited by the connecting-wire of small resistance which connects the contact-piece  $j$  of its switch with the line. It is  
125  
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also evident that when the other switch-plug of the pair is inserted, as described, into the spring jack switch of another line that line is also opened at the contact-points *g h* of its switch, and is therefore disconnected from the ground, and the flexible cord attached to the plug is connected to the line both through the spring-lever *g* and the contact-piece *j* of the switch and connecting-wires. It is also evident that the two wires thus disconnected from the ground are connected together for conversation, and that their annunciators are shunted or short-circuited by wires of small resistance, and that the operator's telephone or the clearing-out annunciator *v* is in the circuit of the wires thus connected as the levers of the switch *Y* are on the bolts *z z* or *y y*. It will also be seen that all the test-bolts *i* of a line are connected to the line whether it is switched for conversation or not. The line-annunciators, being thus shunted or short-circuited by wires of small resistance when their lines are switched for conversation, will not retard the telephone-currents by their magnetic action and will not be actuated by the clearing-out signals, the latter being indicated only by the clearing-out annunciator which is in the circuit.

It will be seen that if the key *k* is depressed the two plugs are separated or disconnected from each other and the plug *D* is grounded through the calling-generator or battery *B*. It will therefore send a calling-current to the line in whose spring-jack switch the plug is placed.

The operation of the test system is as follows: If an operator at any board wishes to find out whether any given line is in use at another board, she places her test plug or device on the test-bolt *i* of the line on her board, and if the line is not in use her test-bell responds because there is a closed circuit from the ground through her test-bell and battery to the test-bolt, and thence through the spring-jacks and connecting-wires of the line to the office ground. If the line, however, is in use, by having a switch-plug in one of its spring-jack switches on another board the bell will not respond, because the circuit traced above is opened. There will of course in the latter case be a complete circuit from the ground through the test-bell and battery through the subscriber's line and apparatus to the ground at the outer end of the line, and if another line is connected to the line tested through that line and its subscriber's apparatus and to ground at its outer end. As stated previously, the bell and battery should be adjusted to each other, so that the bell will not respond when the battery is closed through it and the line-circuits, but will respond when the battery is closed through the circuit from a test-bolt to the office ground, as described above. In practice it will be found that about one cell of battery and a signal of proportionate resistance will answer the requirements of the testing apparatus.

The test-bolts *i i* of a line are connected to

it between the subscriber's station and the switches, and preferably, as heretofore indicated, from a point between the line-annunciator and the switch-springs. The test system would not operate as described if the bolts were not connected to their line between the station and the switches.

The connection between a line and its test-bolts is preferably made, as indicated, with the line-annunciator between the point of connection and the subscriber's station and not with it between the point of connection and the office ground, for the reason that in the latter case a testing-battery would be required strong enough to actuate the testing-bell through the resistance of the line-annunciator and greater care would be required to adjust its strength, so that it would not also operate the bell through the line-circuit of the line tested. It is for this reason that the arrangement of annunciators and circuits herein described is preferable with this system of testing to that shown and claimed in my patent, No. 247,199, of September 20, 1881. I do not, however, wish to limit myself to the particular arrangement of annunciators herein shown and described, as my testing system is intended to include any arrangement of apparatus and circuits wherein the battery and test-bell are so adjusted to each other and to the circuits that the bell will respond when the battery is closed through it and the line spring-jacks and the office ground, and will not respond when it is merely closed through the subscriber's line to the outer ground.

The subscribers' lines shown and described in this specification are closed-circuit lines grounded normally at the central office and grounded at the subscribers' stations and provided with the usual outfits at the stations.

The testing system is applicable to any arrangements of circuits in which the lines are normally grounded at the central and are disconnected from the ground there when switched for conversation.

Where a line is being tested and an annunciator is in circuit with it, whether it be its calling-annunciator or a clearing-out annunciator, the annunciator should be so constructed and adjusted that it will not be actuated by the testing-battery used. Annunciators such as are ordinarily used in telephone-exchange systems when placed in the circuit would not be actuated similar to that indicated above and strong enough to operate the test.

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

1. In a telephone-exchange system, the combination of lines normally grounded at the central office with switches at the central office, one switch for each line, annunciators, one annunciator in each line placed in the central office between the line-switch and the subscriber's station, branch wires, one wire branching from each line between its annunciator and its subscriber's station to an insulated piece of its switch, a pair of switch-

plugs with flexible cords, and a clearing-out annunciator, said clearing-out annunciator being in a circuit which connects the contact-points of the plugs and each of said plugs being adapted when inserted into a switch to disconnect the line which belongs to the switch from the ground and to connect its contact-point to the line both through the calling-annunciator and through the insulated contact-piece of the switch and its branch wire, whereby, by the insertion of the plugs into the switches of any two lines, the lines are disconnected from the ground and are connected together for conversation, their calling-annunciators being shunted or short-circuited by wires of small resistance, and the clearing-out annunciator being in the circuit of the lines so connected.

2. In a telephone-exchange system, two subscribers' lines temporarily disconnected from the ground at the central office and connected together for conversation, with their calling-annunciators shunted by wires of small resistance, in combination with a clearing-out annunciator in the circuit of said lines, substantially as and for the purpose set forth.

3. In a telephone-exchange system, two or more switch-boards at which the same lines are connected, switches, one for each line on each board, and branch wires, one wire branching from each line between its calling-annunciator and its subscriber's station to an insulated piece of its switch on each board, in combination with switch-plugs with flexible cords at each board, each of said plugs being adapted when inserted into a switch to connect its contact-point to the line both through the calling-annunciator and through the insulated contact-piece of the switch and its branch wire, whereby when a plug is inserted into the switch of any line at either board the line is connected to the flexible cord and its calling-annunciator is shunted or short-circuited by a wire of small resistance, substantially as and for the purpose set forth.

4. In a telephone-exchange system, a telephone-line grounded at the subscriber's station and normally grounded at the central office, and a switching device at the central office in the circuit of said line adapted to disconnect the line from the ground and connect it with another line for conversation, in combination with a test-bolt connected to said line between the subscriber's station and the switching device, (whether the line is switched or not,) a local test wire or circuit, said wire or circuit being grounded at one of its ends and connected at its other end to a switch-testing device adapted at the will of the operator to be brought into connection with said test-bolt, a test-receiving instrument and a battery, said instrument and said battery being connected in said test wire or circuit between its end which is grounded and its end which is connected to said switch-testing device, said battery being so small (or weak) that it will not operate said test-receiving instrument when, on the test

being applied and the line being switched for conversation, there is a complete circuit through the test instrument and battery to the ground at the subscribers' stations only, but said battery being so strong as to operate said test-receiving instrument when, on the test being applied and the line being not switched for conversation, there is a complete circuit through the test instrument and battery both to the subscriber's ground and to the office ground of the line, substantially as and for the purpose set forth.

5. In a telephone-exchange system, telephone-lines grounded at the subscribers' stations and normally grounded at the central office, and two or more switch-boards for said lines, each board having a switching device for each line, each switching device being adapted to disconnect its line from the ground and to connect it with another line for conversation, in combination with test-bolts, one for each line on each board, each test-bolt being connected to its line between the subscriber's station and the switching devices of the line, local test wires or circuits, one for each board, each wire or circuit being grounded at one of its ends and connected at its other end to a switch-testing device adapted at the will of the operator to be brought into connection with any test-bolt at her board, a test-receiving instrument and battery for each test wire or circuit, the test instrument and battery being in said wire or circuit between its end which is grounded and the end which is connected to its switch-testing device, and the instrument being at the board to which the test-wire belongs, said battery being so small (or weak) that it will not operate said test-receiving instrument when, on the test being applied and the line being switched for conversation, there is a complete circuit through the test-receiving instrument and battery to the grounds at the subscribers' stations only, but said battery being so strong as to operate said test-receiving instrument when, on the test being applied and the line being not switched for conversation, there is a complete circuit through the test-receiving instrument and the battery both to the subscriber's ground and the office ground of the line, substantially as and for the purpose set forth.

6. In a telephone-exchange system, a telephone-line normally grounded at the central office by a ground-wire of small resistance, and a switching device in the circuit of said line adapted to disconnect the line from said ground-wire and connect it with another line for conversation, in combination with a test-bolt connected to said line between the subscriber's station and the switching device, a local test wire or circuit, said wire or circuit being grounded at one of its ends and connected at its other end to a switch-testing device adapted at the will of the operator to be brought into connection with said test-bolt, a test-receiving instrument, and a battery, said instrument and said battery being connected

in said test wire or circuit between its end which is grounded and its end which is connected to said switch-testing device, said battery being so strong as to operate said test-receiving instrument when closed through the switching device and said ground-wire of small resistance, but so small (or weak) as not to operate said instrument when closed through a larger resistance, substantially as and for the purpose set forth.

7. In a telephone-exchange system, a telephone-line normally grounded at the central office by a ground-wire of small resistance, two or more switch-boards for the exchange, each board having a switching device for said line, each switching device being adapted to disconnect the line from said ground-wire and connect it with another line for conversation, in combination with test-bolts, one for said line on each board, each test-bolt being connected to the line between the subscriber's station and the switching devices of the line, local test wires or circuits, one for each board, each test wire or circuit being grounded at one of its ends and connected at its other end to a switch-testing device adapted at the will of the operator to be brought into connection with the test-bolt at her board, a test-receiving instrument and battery for each test wire or circuit, the test-receiving instrument and battery being in its test wire or circuit between its end which is grounded and its end which is connected to its switch-testing device, and each instrument being at the board to which its test wire or circuit belongs, said battery in each test wire or circuit being so strong as to operate its test-receiving instrument when closed through said switching devices and said ground-wire of small resistance, but so weak (or small) as not to operate said instrument when closed through a larger resistance, substantially as and for the purpose set forth.

8. In a telephone-exchange system, a telephone-line normally grounded at the central office, a switching device for said line adapted to disconnect the line from its office ground and connect it with another line for conversation, and a calling-annunciator in the circuit of the line between the subscriber's station and the switching device, in combination with a test-bolt connected to said line between said calling-annunciator and said switching device, said test-bolt being adapted to be connected at the will of the operator with a test wire or circuit grounded at its other end, in which wire or circuit is a test-receiving instrument and battery, substantially as and for the purpose set forth.

9. In a telephone-exchange system, two or more switch-boards at which the same lines

are connected, switches, one on each board for each line, calling-annunciators, one for each line and connected in the circuit of its line between the subscriber's station and the switches of the line, test-bolts, one for each line on each board, each test-bolt being connected to its line between the line-switches and the calling-annunciator, each test-bolt being adapted to be connected at the will of an operator to a test wire or circuit at its board, in which is a test-receiving instrument and battery, and branch wires branching from each line between its subscriber's station and its calling-annunciator to an insulated piece of its switch on each board, in combination with switch-plugs with flexible cords at each board, each of said plugs being adapted, when inserted into a switch, to connect its contact-point to the line both through the calling and through the insulated contact-piece of the switch and its branch wire, all substantially as and for the purpose set forth.

10. In a telephone-exchange system, the combination of the subscribers' lines, the switch-boards, the switches, the annunciators, circuit-connections between the switches and the subscribers' lines through the annunciators, and separate circuit-connections between the subscribers' lines and the switches around or shunting the annunciators, substantially as set forth.

11. In a telephone-exchange system, the combination of a multiple switch-board, the subscribers' lines, the switches, one for each line in each board, their circuit-connections, the test-bolts, one for each switch, connected to the lines between the subscribers' stations and the switches, the test-circuits connected with the lines, but normally in open circuit therewith, a battery and signaling device in the test-circuit, and a test-plug adapted to close the test-circuit at the test-bolt of any line, substantially as set forth.

12. In a telephone-exchange system, the combination of a multiple switch-board, the subscribers' lines, the switches, one for each line in each board, their circuit-connections, the test-bolts, one for each switch, the test-circuit closed through the main line when the line is connected up, but closed through a local circuit when the line is free, said test-circuit including a signaling device and a battery of sufficient strength to operate the signal when a circuit is closed through the unopened switches, but too weak to operate the signal through a circuit including one or more subscribers' lines.

MILO G. KELLOGG.

Witnesses:

MILTON HEAD,  
CALVIN DE WOLF.