(No Model.)

M. G. KELLOGG.

MULTIPLE SWITCH BOARD.

No. 382,474. Patented May 8, 1888.

Fig. 1a.

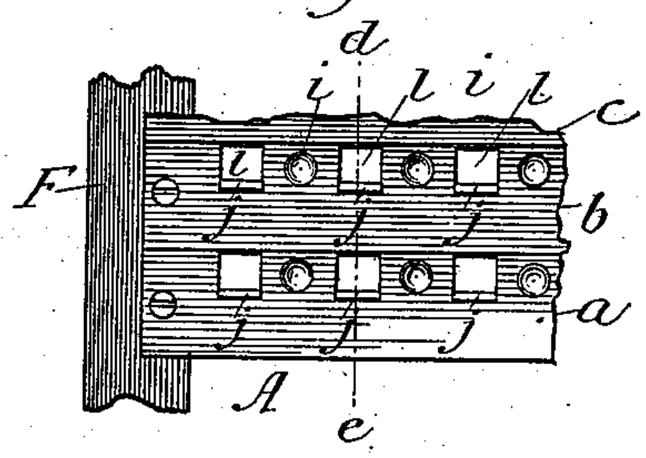

Fig. 1b.

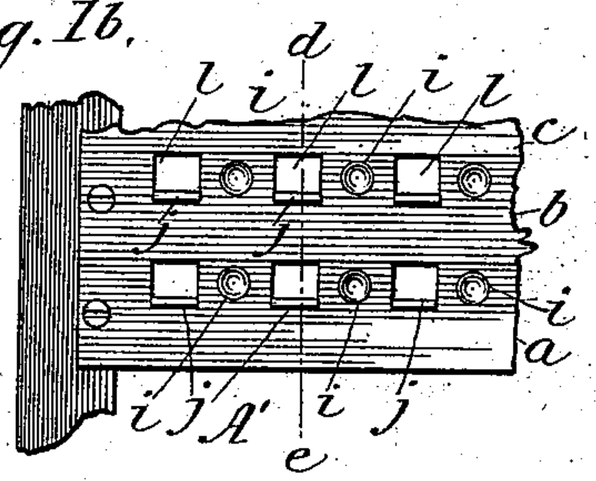

Fig. 2

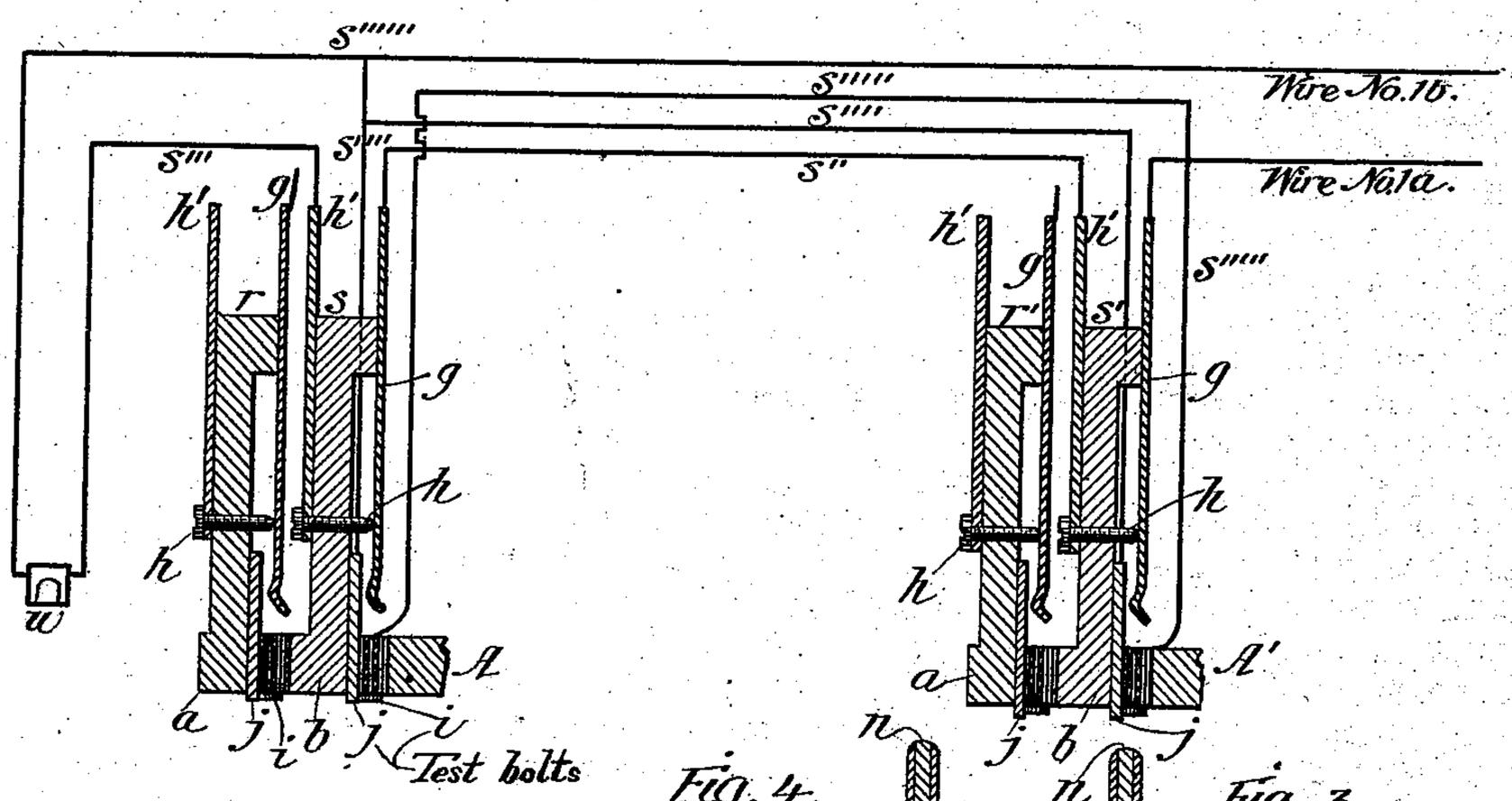

Fig. 4.

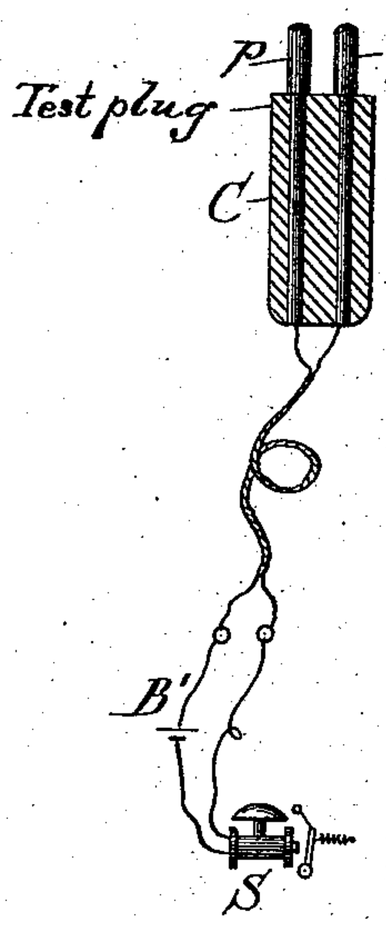

Fig. 3.

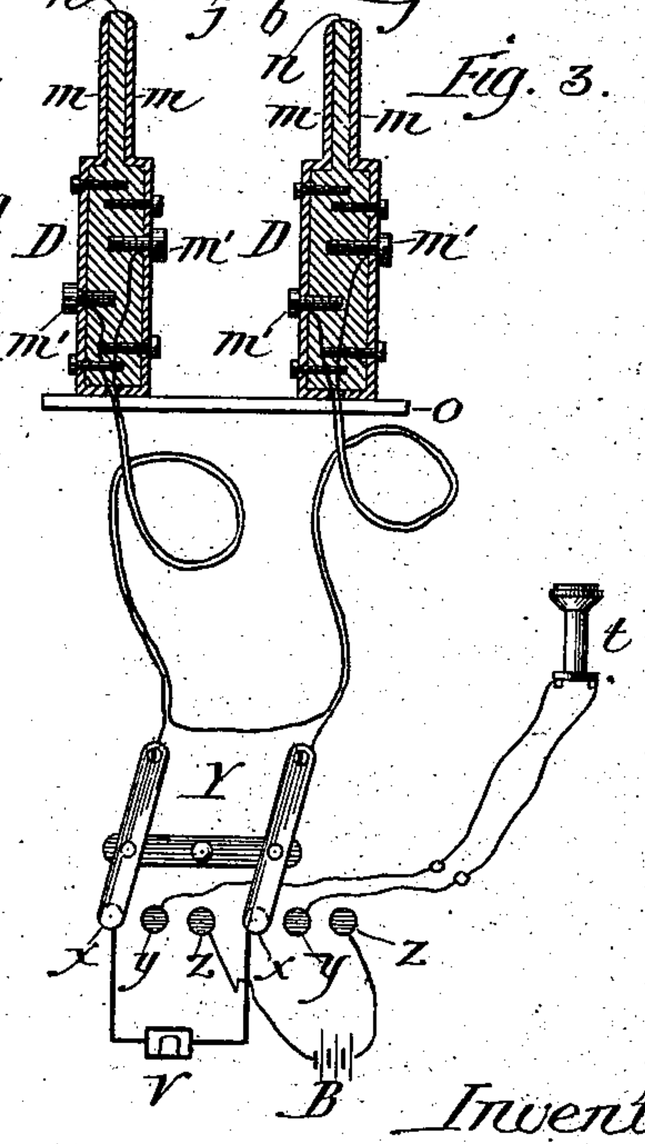

Fig. 5.

Fig. 6.

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MILO G. KELLOGG, OF HYDE PARK, ILLINOIS.

MULTIPLE SWITCH-BOARD.

SPECIFICATION forming part of Letters Patent No. 382,474, dated May 8, 1888.

Application filed April 13, 1887. Serial No. 234,670. (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 to a telephone-exchange system in which the subscribers' lines are metallic circuits.

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 a certain construction of spring-jack switches and test-bolts, which I shall hereinafter describe and claim in detail, said invention in spring-jack switches and test-bolts being applicable to said multiple switch-board system mentioned above and to other systems of telephone-exchange switch-boards.

It consists, thirdly, of an operator's central-office system of cords, with plugs, switches, telephone, battery or generator, annunciators and circuits for answering, calling, switching, and clearing out subscribers' lines, which 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 use loop switch-plugs having two insulated metal pieces and two insulated flexible conductors attached to said pieces. I place as many switch-boards in the central office as are found necessary or desirable in order to properly 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 two insulated contact-points normally in contact, said switches being adapted to receive a plug, and when the plug is inserted to disconnect the contact-points and connect the two sides of the line thus opened to the two insulated pieces of the plug, respectively, and when the plug is withdrawn to again connect the contact points. On each board I also place for each of the telephone-lines two test-bolts or contact-pieces insulated from each other and from the other parts of the apparatus, except as shown and described. The test-bolts of a line on a board may be adjacent to the spring-jack switch of the line; or they may be placed in any other situation, provided they are so marked and located that the operator may know to what line they belong. In the apparatus shown in the drawings, and which I shall hereinafter describe, one of the test-bolts of each line on each board and one of the contact-pieces of the spring-jack switches of the line on each board, by which one side of the line is connected with one contact-piece of a plug, when it is inserted, are one and the same piece. They may, however, be separate pieces and properly insulated and connected. The switches of a line on the different boards may be called a "series of switches," and the test-bolts of a line on the different boards may be called a "series of test-bolts." As there are two test-bolts for each line on each board, they may be called "a series of double test-bolts."

Figures 1ª and 1ᵇ 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 the circuits and connections necessary to operate them when used in connection with the operator's testing system and cord system, hereinafter described. Fig. 3 shows a diagram of the operator's cord system for receiving and answering calls and switching and clearing out subscribers' lines. Fig. 4 shows an operator's testing system, including a test-plug, a battery, an electric bell and connections. Fig. 5 shows a side view of the testing-plug. Fig. 6 shows a side view of a switching-plug.

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

Each operator has one testing system and one cord system. These should be placed in convenient arrangement at the board which she attends, so that she can conveniently operate the exchange system.

In Fig. 2, A is a sectional view of the switch-board shown in Fig. 1ª, as indicated by line *d e*, and A′ is a sectional view of the switch-board shown in Fig. 1ᵇ, as indicated by line *d e*.

a b represent rubber strips of the shape substantially as shown, on which the metal parts of the spring-jack switches and the test-bolts are mounted. These strips may be of a length 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 in the rear of and are parallel to the holes *l l*, to which they belong, as shown. The contact-points *h h*, &c., corresponding to the contact-springs, pass through the rubber strips and have connecting-pieces *h'*, as shown.

j j, &c., are contact-pieces, each adapted to connect one side of its line with one of the contact-pieces of a plug when it is inserted into its switch, and also to be one of a pair of test-bolts for its line at its board. The switch-plugs are substantially as shown, and as will hereinafter be described.

The several parts mentioned above are so shaped, arranged, and adjusted that when a plug is inserted into any of the holes it raises the spring in the rear of the hole from its contact-point, (on which it normally rests,) and the spring is connected to one of the contact-pieces of the plug, and the other contact-piece of the plug is connected to the contact-piece *j* of the switch which is being used.

Each section of a rubber strip, with its contact-spring, contact-point, contact-piece, and the hole, all arranged and operating as shown and described, may be considered as 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 of the strip which is below it, as shown. It is not necessary that the holes should be actually square, as their shape might be made to conform to the shape and arrangement of parts used.

i i, &c., are test-bolts, one for each line on each board, each having as its mate a contact-piece, *j*, which also acts as a test-bolt, and near which it is for convenience placed.

The circuit and connections of a subscriber's line to its series of switches and of test-bolts is as follows and as shown. I have marked the two wires of such a line wire No. 1^a and wire No. 1^b. Wire No. 1^a, after entering the office, is connected to its spring *g* of its switch *s'*, (one of its series of switches,) and thence through contact-point *h* and contact-piece *h'* of that switch and wire *s''* to spring *g* of switch *s*, (another of its series of switches,) and thence through contact-point *h* and contact-piece *h'* of that switch and wire *s'''* to its annunciator *w*, and thence by wire *s'''''* to wire No. 1^b. I also connect wire No. 1^a, before it passes to and is connected to any contact-spring *g* of its series of switches, to all of its test-bolts *i* of its series of test-bolts. This is done by means of branch wires *s''''*. I also connect wire No. 1^b, before it passes to the annunciator or to any of the contact-points of its series of switches, to all of the contact-pieces *j* of its series of switches. This is done by means of branch wires *s''''*. Every other linen is in like manner connected to its series of switches and of test-bolts. Other boards might be used, and the circuit and connections of a line through its series of switches and to its test-bolts would be similar to that described above and such as would be evident to those skilled in the art.

In the operator's system of cords shown in Fig. 3 only one pair of cords with its plugs, switch, and clearing-out annunciator is shown. Other pairs needed could be added and connected to the operator's telephone and generator or calling-battery in a manner which is apparent to those skilled in the art.

D D represent a pair of plugs in sectional view, as indicated by line *d e* in Fig. 6.

n is the rubber insulation of the plug.

m m are the two contact-pieces of the plug, and *m' m'* are two contact-screws to connect the insulated conductors of the cord to the contact-pieces of the plug. The contact-pieces *m m* extend to the bottom of the plug, as shown, and are adapted to rest normally (or when the plug is not in use for switching) on the metal piece *o*, and thereby temporarily connect them together.

Y is a looping-in switch having three pairs of contact-bolts, *x x*, *y y*, and *z z*, on either of which the operator may at will place the two levers of the switch.

v is the clearing-out annunciator of the pair of cords.

B is the calling generator or battery, and *t* is the operator's telephone of the cord system.

It is evident that when the levers of the switch are on *x x* the clearing-out annunciator is in the circuit of the flexible conductor, connecting one piece *m* of one plug with one piece *m* of the other plug; that when the levers are on *y y* the operator's telephone is in this circuit, and when they are on *z z* the calling-generator is in this circuit. The other pieces *m* of the two plugs are connected to each other, as shown, by a flexible conductor. The flexible conductors should be of sufficient length to accommodate the work of switching at the board where they are to be used, and for convenience may be bound together into a double insulated conductor, as is shown, and as is usual.

In the operator's test system (shown in Fig. 4) the test-plug is shown in sectional view, as indicated by line *d e* in Fig. 5.

C is the rubber handle of the plug.

p q are two contact-pieces, so made, placed, and adjusted that the operator can readily connect them simultaneously to any two double test-bolts, *i* and *j*, of her board—as, for instance, *p* to *i* and *q* to *j*, respectively, or the reverse.

S is an electric bell or other test-receiving instrument, and B' is an electric battery, both in a loop which connects the two contact-pieces *p* and *q*, as shown. The connection between

the apparatus S and B and the plug is by flexible conductors of sufficient length, so that the operator may apply the contact-pieces of the plug to any pair of test-bolts *i j* at her board. The bell and battery should, preferably, be adjusted to each other, so that the bell will respond when the battery is closed through a circuit of small resistance—as, for instance, that of the bell—one of the calling-annunciators of the exchange and the connecting-wires of a line through the office, and will not respond when the battery is closed through a circuit of considerably larger resistance—as, for instance, that of the bell and the resistance of an ordinary subscriber's line and apparatus connected in the exchange. The reason for this will be apparent when the operation of testing is explained.

It is evident that when a switch-plug is inserted into any spring-jack switch of a line the line is opened between the contact-pieces *g h* of the switch, and the two sides thus opened are connected to the two contact-pieces of the plug through their contact with pieces *g j* of the switch, and that any circuit or apparatus connected to the contact-pieces of the plug is looped into the circuit of the line. It is also evident that when there is not a plug in either of the switches of a series of a line there is a complete circuit through the switch-boards from any test-bolt *i* of test-bolts of the line to its corresponding test-bolt, *j*, and that when there is a plug in any switch of a line the circuit of the two test-bolts is opened. If the operator applies her test-plug to the test-bolts *i j*, as indicated, and the bell responds, she therefore knows that the circuit between these bolts is not open, and that the line is not switched for use at any other board. If the bell does not respond, she knows that the line is in use.

The operation of the whole exchange system is as follows: When a subscriber sends a calling-current over his line, the annunciator at the office indicates a call, and the operator to whom this annunciator is assigned places one of a pair of plugs in the spring-jack switch of the line on her board and moves the levers of the switch corresponding to that plug to bolts *y y*. Her telephone is thus looped into a circuit with the line, and she finds out by conversation what other subscriber's line is wanted. She then applies her test-plug to the test-bolts of the line which is wanted, and if it tests "in use" she so notifies the calling-subscriber and withdraws the plug from his spring-jack switch. If, however, the line does not test "in use," she places the other plug of the pair in its switch. The two lines are thus connected into one metallic circuit through the medium of the two plugs and the double conducting-cords which connect them. The operator will now move the levers of the switch, so that they rest on bolts *z z*, and the calling generator or battery will be looped into the circuit of the wires thus connected together, and will send a signaling-current through it to ring the bell of the subscriber who is wanted. By moving the levers to bolts *x x* the clearing-out annunciator is looped into that circuit and on it the operator will receive any clearing-out signal sent from either station. She can at any time, while they are connected for conversation, move the levers to bolts *y y*, and thus looping her telephone into the circuit determine whether the subscribers are through conversation. The levers of switch Y should normally rest on *x x*.

The subscribers' lines are metallic circuits extending to their stations and through the telephone and calling apparatus there located, (which may be of the usual kind,) and thence back to the central office and through the switches, as described. It will be seen that there is always a circuit between any pair of test-bolts *i j* through their line; or if the line is looped with any other circuit the two circuits form branches of a circuit between the two bolts. The battery for testing should not be strong enough to operate the testing-bell through such a circuit.

My invention in spring-jack switches is an improvement in that class of loop spring-jack switches in which the spring contact-point is in the rear of the face of the switch, and in which there is a hole in the face of the face of the switch adapted to guide the plug so that it may come in contact with and operate said spring contact-piece. This class of switches has been found best adapted for use in telephone-exchange systems, for the reasons that the spring is better protected from injury than it would be if it were on the face of or projected to the face of the switch, and that it is the most compact construction of switches yet devised, allowing a great number of line-switches to be grouped in a comparatively small space. Heretofore in this class of switches the plug-holes have been round and the plugs adapted to fit them have also been round, and the plugs have been guided by the holes only in the direction longitudinal to the plugs. Such a construction of switches requires that the contact-pieces of the plugs should be cylinders in order to form the proper connections in whatever positions laterally the plugs may take. To construct these plugs with their several contact-pieces and cylinders properly insulated from each other is difficult and expensive and makes the plug complicated.

In my improvement the holes are made rectilinear, and the plugs are also made rectilinear to fit the holes and to be guided by them, both in their horizontal and in their lateral directions, until and after they have been inserted far enough to make the necessary switch-connections. In this construction of apparatus the contact-pieces of the plugs are planes, and one or more of them can be placed on a face of the plug. The plugs are easy of construction, and when inserted in the switches will always be guided so as to make the necessary connections whatever may be the number and character of the switch and the plug contact-pieces. My invention does not apply to those switches

in which all the contact-pieces are on or project to the face of the switch, or to switches in which the plugs do not require to be guided in their horizontal and lateral directions after they are inserted and before they have completed the intended connections.

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

1. A spring-jack switch containing a spring-lever, a contact-point, and a contact-piece mounted on an insulating-strip, said lever being transverse to the front of said strip and said contact-point being so placed that said lever normally bears on it, said strip having through its front a transverse rectilinear hole in front of said lever and said contact piece being mounted on one of the sides of said hole, in combination with a double or loop plug adapted, when inserted into said hole, to separate the spring-lever from the contact-point and form connection between its two contact-pieces and the lever and contact-piece of said switch, substantially as and for the purpose set forth.

2. The combination, with a strip of insulating material having transverse rectilinear plug-holes through its front, of the metal parts of several spring-jack switches mounted thereon, each metal part consisting of a spring-lever placed transverse to the front of said strip and in the rear of a plug-hole, a contact-point so placed that the lever normally bears on it, and a contact-piece mounted on one of the sides of said hole, all substantially as and for the purpose set forth.

3. In a spring-jack switch, the movable contact-piece and another contact-piece, both suitably mounted and insulated, said movable contact-piece being mounted and located back of the face of the switch, said face having a transverse rectilinear hole in front of said movable contact-piece, said hole being adapted to receive a rectilinear switch-plug and to guide it in its horizontal and lateral directions until it moves said movable contact-piece, and said other contact-piece being mounted on one of the faces of said switch-hole, in combination with a rectilinear loop switch-plug adapted to fit said hole and be guided by it in its horizontal and lateral directions, said plug having two contact-pieces, each a plane and on a face of said plug, said plug being adapted after being inserted into said hole to move said movable contact-piece and to have one of its contact-pieces form connection therewith and its other contact-piece form connection with said other contact-piece of the switch, substantially as set forth.

4. The combination of spring-jack switches mounted on an insulating-strip and having their plug-holes through the front of said strip, with pairs of contact-pieces, one pair for each switch-hole, one of each pair forming a face of said hole, and the other piece of each pair being adjacent to it on the front of said strip, substantially as and for the purpose set forth.

5. The combination of pairs of contact-pieces placed at a multiple switch-board, one pair for each line which is connected to the board, one piece of each pair forming a face of its switch-hole and the other being adjacent to it, with a double test plug or device attached to a double flexible cord, said test plug or device having two insulated metal pieces so made, placed, and adjusted that the operator can readily connect them to any pair of said contact-pieces, substantially as and for the purpose set forth.

6. In a telephone system, a metallic-circuit telephone-line, a loop-switching device in the circuit of said line adapted to loop another circuit into the circuit of said line, and a pair of test-bolts, one of the bolts being connected to the line on one side of the switching device and the other bolt being connected to the line on the other side of the switching device, in combination with a testing plug or device having two contact-points connected by a loop in which is a battery and a test-receiving instrument, and said contact-points being adapted to be brought into contact with said test-bolts, whereby the operator may by testing determine whether another line has been looped into the circuit of said line.

7. In a telephone system, a metallic-circuit telephone-line, two or more loop-switching devices in the circuit of said line, each adapted to loop another line into the circuit of said line, and a pair of test-bolts, one of the bolts being connected to the line on one side of the switching devices, and the other bolt being connected to the line on the other side of the switching devices, in combination with a testing plug or device having two contact-points connected by a loop in which is a battery and a test-receiving instrument, and said contact-points being adapted to be brought into contact with said test-bolts, whereby the operator may by testing determine whether or not some other line is looped into the circuit of said line at some one of the switching devices.

8. In a telephone system, two or more metallic-circuit telephone-lines, each having two or more loop-switching devices in its circuit, each switching device being adapted to loop another line into the circuit of its line, and pairs of test-bolts, one pair for each line, and one bolt of each pair being connected to its line on one side of its switching devices, and the other bolt of the pair being connected to its line on the other side of its switching devices, in combination with a testing plug or device having two contact-points connected by a loop in which is a battery and a test-receiving instrument, said contact-points being adapted to be brought into contact with any pair of said test-bolts, whereby the operator may by testing determine whether or not either of said lines is in use.

9. In a telephone-exchange system, two or more multiple switch-boards for the lines provided with series of switches, one series for each line, and one switch of each series arranged on each board, and each line passing through its series, switch-plugs adapted to be

inserted into any of said switches, and when inserted to open the line at the contact-points of said switch, and series of pairs of test-bolts, one series for each line, and one pair of each series on each board, one bolt of each pair being connected to its line before the line passes to its switches, and the other bolt of the pair being connected to the line after it has passed through its switches, in combination with testing plugs or devices, one at each board, and each having two contact-points connected by a loop in which is a battery and a test-receiving instrument, the two contact-points of the testing device being adapted to be brought into contact with any pair of test-bolts at its board, whereby the operator at any board may by testing determine whether or not either of said lines is in use.

10. In a telephone system, a metallic-circuit telephone-line, a loop-switching device in the circuit of said line adapted to loop another line into the circuit of said line, and a pair of test-bolts, one of the bolts being connected to the line on one side of the switching device, and the other bolt being connected to the line on the other side of the switching device, in combination with an operator's testing system consisting of a testing plug or device with two contact-pieces and a battery, a test-receiving instrument, and a loop, said contact-pieces being connected by the loop and being adapted to be brought into contact with said test-bolts, said loop containing said battery and test-receiving instrument, and said battery and test-receiving instrument being so adjusted to each other that the instrument will respond when the testing device is applied to the test-bolts and no other line is looped into the circuit of said line, but will not respond when another line is looped into the circuit, substantially as and for the purpose set forth.

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