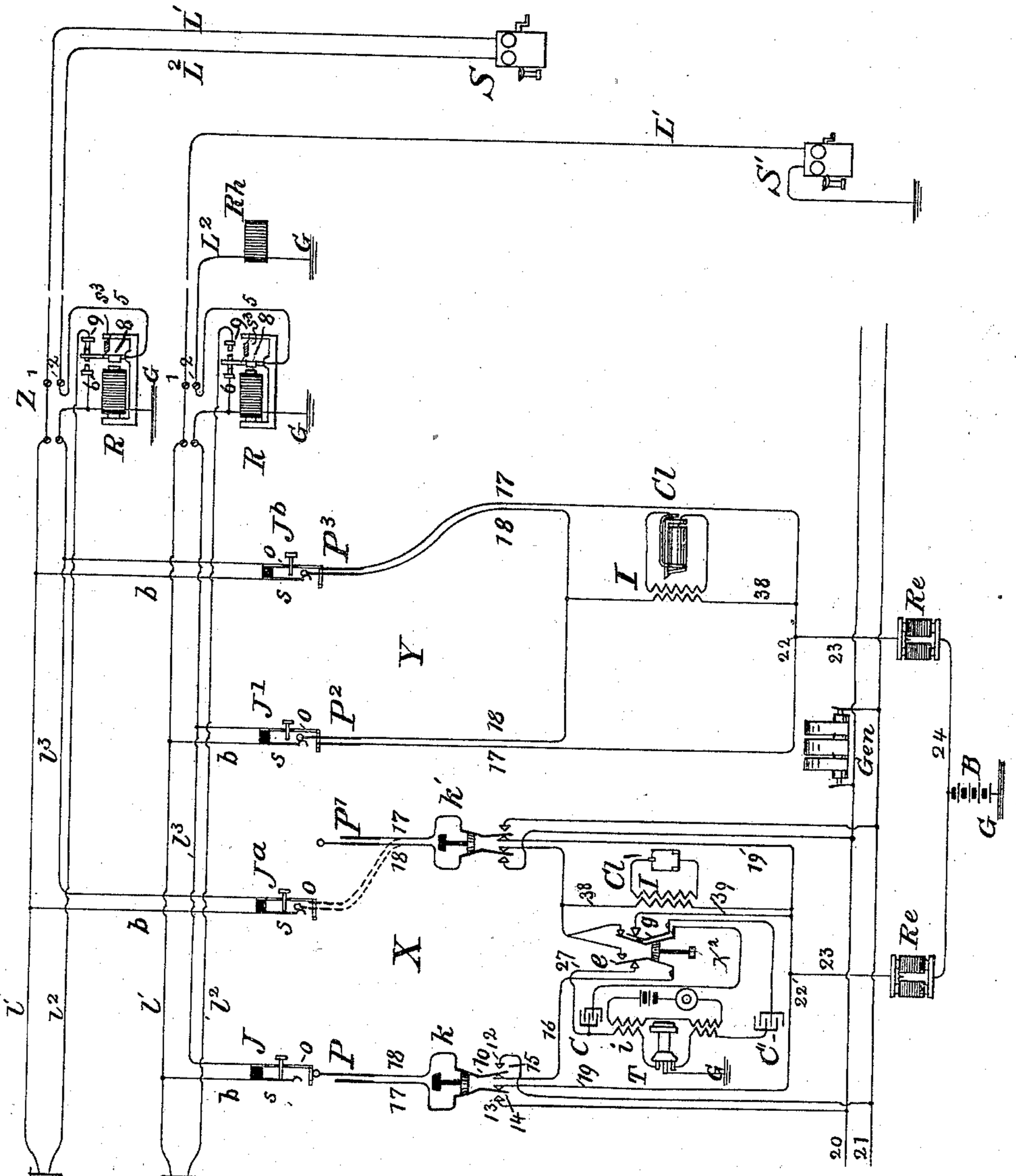
(No Model.)

J. L. McQUARRIE.

TELEPHONE CENTRAL STATION CIRCUIT.

No. 492,484. Patented Feb. 28, 1893.



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TELEPHONE CENTRAL-STATION CIRCUIT.

SPECIFICATION forming part of Letters Patent No. 492,484, dated February 28, 1893.

Application filed September 8, 1892. Serial No. 445,315. (No model.)

To all whom it may concern:

Be it known that I, JAMES L. McQUARRIE, residing at Boston, in the county of Suffolk and State of Massachusetts, have invented certain Improvements in Telephone Central-Station Circuits, of which the following is a specification.

This invention relates to improvements in multiple switchboards employed in telephone exchanges or central offices for the purpose of interconnecting the several substations connected thereto.

To improve the telephone service by securing the best results from the apparatus employed, is an object of the highest concern in the management of such service and whenever an established exchange can be made to produce better results by an alteration of the existing means of operation instead of by a replacement of the old by entirely new apparatus, economy and good business indicates this to be the road to pursue.

To this end my invention consists in the application of means and in a rearrangement of circuits in and to an old multiple switchboard so that it may have all the advantages of a modern branch terminal switchboard in its freedom from increased line resistance due to dirty jack contacts and also in the elimination of a false busy test frequently developed in the present type of metallic circuit multiple switchboards.

Experience has demonstrated that in multiple switchboards the springjacks when connected in series, as has been the universal practice in the past, have been the cause of considerable trouble by reason of the accumulation of dirt upon their contacts, adding greatly to the resistance of the circuits of which they form a part. To remove this trouble is one part of my invention, and I effect this result by excluding from the talking circuit, when the operator's connecting cords are up, all of the springjacks in the series excepting those to which the said cords are connected.

The second part of my invention relates to alterations in the ordinary type of metallic circuit multiple switchboards to eliminate any false busy test, which when the line circuit is in parallel for any distance with a power current wire, comes into the central office over the limb of the circuit which is connected to the test rings of the several jacks in the series—either as a current or a static charge on the said limb, and produces in the operator's telephone a click very similar to the legitimate test click, when she makes a trial to see whether the line is busy or not, occasioning a serious disturbance in the operation of the exchange.

In the metallic circuit multiple switchboard systems as commonly used, a substation line entering the central station has one side of the line connected to the spring of the jack on the first section, the circuit being from the spring through a contact screw to the spring of the jack in the next section, &c., and finally passing to one side of the line annunciator; the other side of the line connects to the frame of each spring jack in the series, and then to the opposite side of the line annunciator. Serious defects have been found in this method of connecting as before stated.

In carrying out my improvements, I provide that one side of a substation line entering the central station shall branch to the springs of each jack upon the several sections of the switchboard, and terminate at one side of the line annunciator; the other side or second wire of the line circuit comes in through the armature of a relay and normally through its back contact and connects to the opposite side of the line annunciator. A third wire branches, first, to the frames of the several jacks in the series, and, second to the normally open front contact of the relay armature, and, third, through the high resistance helices of the said relay to ground. The path of a single or grounded subscriber's line through the switchboard is substantially the same as that of the metallic circuit, except that the side of the line connecting with the relay armature is grounded in the central station through a resistance coil instead of returning through the subscriber's station. I employ a relay of high resistance or retardation; as described, the coils of the relay are legged from one side of the said "third" wire to the ground. The armature of the relay makes a front and back contact; when the

line is disconnected the armature rests upon the back contact closing the outside line through the line annunciator without including the test rings or frames of the jacks. This arrangement removes the test ring or jack frames entirely from the line and overcomes the liability to false busy test which comes in when one side of the line connects with the said rings; and when the line is connected or in use the relay armature is in contact with its front contact, closing the line through the test rings, and the board is in condition for talking. The keyboard or operator's apparatus and connections differ in some respects from the present boards, to meet the alterations made in the line circuits. The usual "split" telephone and transmitter are used connected across the cord circuit. Instead of the clearing out annunciator being connected in across the cord circuit, the primary wire of a transformer or repeating coil is bridged therein, the coils being preferably of high resistance, the object being to reduce the shunting effect upon the talking current and also to increase the ringing effect upon the secondary wire of the coil, which extends to and includes the clearing out annunciator in a local circiuit. I employ a polarized clearing out annunciator. From the "sleeve" side of the cord circuit a branch extends through a retardation coil to the general battery (which is increased in size) and ground. In the telephone circuit across the cords is placed a condenser to prevent in a measure the battery current from passing through the operator's telephone. Another condenser is placed in the "tip" conductor of the cord, to prevent a false test, precisely the same as in the present operator's apparatus.

In the drawing, A designates a central telephone station showing the terminal circuits of two substations, one of which S is a metallic circuit line, the other S′ being a grounded line. The keyboard, or operator's apparatus and circuits for the two substation circuits are shown; the two circuits being represented as connected for conversation by the operator's apparatus Y, while the other operator's apparatus X is shown in the act of testing to see if one of the lines is in use. The line wires L′ L² terminate at points 1, 2, on the cross or distributing board Z at the central station. At this point the wire L′ extends as *l′* through the multiple board, connecting with the line spring *s* of each jack J by means of branches *b*, to one side of the line annunciator D. The other side of the line L² extends from the crossboard Z by wire 5 to the armature 8 of the relay R, and through the back contact 9 to the other side of the line drop D by wire *l²*. One side of the relay magnet coil is grounded; the other side of the coil legs to the front contact 6, thence through the cross board to the test rings or frames of all the multiple jacks. The circuit of the grounded substation line is the same as that of the metallic circuit, except that the side of the line connecting with the relay armature is grounded at the central station through a resistance coil R^h.

Y indicates a keyboard or operator's apparatus, consisting of a pair of cords and plugs connecting the two substations S and S′ together for conversation, the plugs P^2 and P^3 being inserted into jacks J′ and J^b of each circuit respectively. A polarized clearing out annunciator *Cl* is shown in the closed secondary circuit of induction coil I, the primary of which is bridged between the "tip" and "sleeve" cords 18 and 17. The sleeve cord 17 is legged at point 22 by wire 23 through retardation coil *Re* and battery B to ground. The polarized annunciator *Cl* may be any suitable kind; the induction coil I is of high resistance.

X indicates the circuits of the keyboard or operator's apparatus when a test is being made to ascertain whether a line is busy or not. The tip of the test plug is shown as touching the test ring *o* of the terminal jack J of the substation S′; the listening key K^2 being pressed in, introducing the operator's telephones into the cord circuit.

K and K′ are calling keys upon the depression of which the cord circuit is broken at points 14 and 15 and contacts made at 13 and 12 with wires 17 and 18, and with wires 20 and 21 introducing generator *Gen* into circuit in a manner well understood.

As the changes I make in the listening operator's apparatus are slight, I will refer to them in the description of the operation of the same.

The operation of my improvements in connection with metallic multiple switchboards is as follows:—In the normal, or disconnected condition of the circuits, the relay armature 8, of each relay in circuit, stands against the back contact 9, being retracted thereto by its spring s^3. In this condition, when a subscriber signals the central station, the current passes over the switchboard cable wire L′, *l′* connecting with the line springs of all the jacks, to the annunciator D, thence by wire l^2 to the back contact 9 of the relay R through the armature 8 to the substation S by wire L²; that portion of the line l^3, which connects with the test ring of the jacks being disconnected from the subscriber's line. When the operator inserts her answering plug as P′ in the answering jack as shown in dotted lines at X, a portion of the current from battery B, enters the sleeve conductor 17 of the operator's plug cord, through the retardation coil *Re*, and passes over the switchboard cable wire l^3 connecting with all the test rings of the calling subscriber's line, and through the relay R to ground, or a wire which answers the same purpose of a ground, to the other side of the battery B. This energizes the relay magnet, and draws the armature 8 away from the back contact 9 and against the front contact 6, so that the wire l^3 connecting with the test rings becomes one

side of the metallic circuit. The battery current maintains the relay armature in this position, with the front contact, so long as the line is used for conversation, and provides a means for busy test substantially as employed on the present boards. When the helix or helices of the relay become energized, as described, by means of the current from battery B, and its armature 8 is attracted and makes contact in its forward movement with the normally open contact 6, the second wire L^2 of the pair connecting with the substation is opened by the said armature leaving its back contact 9, and remains open while the plug P is in the jack J for the operator to answer a call, or while two lines are plugged together for conversation. The opening of the wire L^2, and the transferring of the third wire l^3 into place as a portion of the line circuit, leaves the line annunciator on an open branch, where it will not be affected by any electric current, either from the sub or central station. It will be seen that the difficulty experienced with the busy test on metallic circuits will be obviated for the reason that the test ring has no connection with the outside line, except when it is used for conversation. It is desirable to use a somewhat stronger test battery, B, than is ordinarily used, in order to work the relay with considerable strength, and to prevent the clearing out annunciator from falling when a plug is inserted in a grounded substation line, in a switchboard having mixed metallic and grounded circuits. I have provided an induction coil or transformer I, the primary wire of which is bridged across the operator's cord circuit in the same position that the present clearing out annunciator is located. The secondary wire of the coil forms a closed circuit including a polarized clearing out annunciator *Cl*. By this arrangement, when a plug is inserted in a grounded line, the battery current which flows from the sleeve side 17 to the tip side 18 of the cord (through the bridged wire 38 and primary of the induction coil I) does not affect the clearing out annunciator because the induced current in the secondary coil flows in an opposite direction to that of the current designed to release the shutter of the polarized relay. When conversation has ceased, the alternate current from the substation generator, as a "ringing off" signal, throws down the shutter of the clearing out annunciator.

If the clearing out annunciator was placed directly in the bridge between the cords, the constant pull of the battery current circulating in its coil would reduce its sensitiveness to the alternate current which is designed to operate the annunciator armature.

When the listening key k^2 is pushed in for answering or connecting, the circuit instead of being from tip to tip, and from sleeve to sleeve of the connecting cords, as shown in keyboard apparatus Y, is broken and the operator's telephones are looped in as shown at X; and in the telephone circuit across the cords, is placed an additional condenser C', to prevent in a measure the current from battery B passing through the operator's telephone T, as when the operator connects in a jack the answering plug, say plug P' in jack J^a, current flows from battery B, wire 24 resistance R*e*, a portion will pass by wire 39 which will be prevented from passing to the operator's telephone T by the condenser C', the main portion of the current passes by wire 19 sleeve cord 17 of plug P', frame *o* of jack J^a, wire l^3 to ground through relay R, energizing the helices of the relay and attracting the armature 8 from its back contact 9 to the forward contact 6 thus transferring the circuit from wire l^2 to wire l^3, the battery B being on the line all of the time the plugs P' are in the jack J^a, the relay helices continue energized.

Condenser C is placed in circuit of the tip conductor of the cord to prevent a false test precisely the same as in the present operator's apparatus.

When a test is made and the line wanted is busy, the circuit is from ground, battery B, through resistance R*l*, wire 23 to point 22 of cords at Y wire 17 to sleeve of plug P^2, frame *o* of jack J^a, wire l^3, frame *o* of jack J plug P, cord 18, wire 16, spring *e* of listening key k^2, wire 27, telephone T to ground; a circuit being found, a click is heard in the telephone. If the line is not busy, no circuit is found, there being no plugs connected to the line the battery is not connected with the circuit and consequently no sound is heard in the telephone. It will be seen the grounds of the testing circuit are both at the central station, and are not exposed to induction or leakage from outside circuits.

I claim as my invention—

1. In a metallic circuit multiple switchboard system, a pair of wires forming the signaling circuit from a substation, one side or wire of which branches to the line springs of each jack in the series, one at each section of the switchboard, and terminates at one side of the line annunciator; the other side or second wire of the said pair being normally connected by means of the armature of a relay upon its back stroke to the other side of said line annunciator; and a third wire branching first, to the frames or test rings of each line-jack in the series, and second to a normally open contact, adapted to be closed by said relay armature upon its forward stroke, and third through the high resistance helix of said relay to ground.

2. In a metallic circuit multiple switchboard system, a pair of wires forming the signaling circuit from a substation, one side or wire of which branches to the line springs of each jack in the series, one at each section of the switchboard, and terminates at one side of the line annunciator; the other side or second wire of the said pair being normally connected by means of the armature of a relay

upon its back stroke to the other side of said line annunciator; and a third wire branching, first to the frames or test rings of each line jack in the series, and second to a normally open contact, adapted to be closed by said relay armature upon its forward stroke, to permit the said third wire to become a side of the circuit in place of the said second wire, and third a branch through the high resistance helix of said relay to ground.

3. In a metallic circuit multiple switchboard system, a high resistance induction coil bridged in between the tip and sleeve sides of the connecting cords of the operator's keyboard apparatus, the secondary wire of the said coil forming a closed circuit and including a polarized clearing out annunciator.

4. In a metallic circuit multiple switchboard system, two or more pairs of wires forming the signaling circuits from two or more substations, one side or wire of each pair branching to the line springs of each jack in the series one at each section of the switchboard and terminating at one side of the line annunciator; the second wire of each of the said pairs being normally connected by means of the armature of a relay, upon its back stroke, to the other side of said line annunciator; and a third wire branching, first to the frames or test rings of each line jack in the said wires, and second to a normally open contact adapted to be closed by said relay armature upon its forward stroke, and third through the high resistance helix of said relay to ground; combined with the connecting plugs and cords of an operator's keyboard apparatus, each pair of plugs having a high resistance induction coil bridged in between the tip and sleeve sides of said cords, the secondary of the said coil including in a closed circuit a polarized clearing out annunciator, and a branch to ground legged to the sleeve side of the cords, including a resistance and battery, as set forth.

5. In a metallic circuit multiple switchboard system, two or more pairs of wires forming the signaling circuits from two or more substations, one side or wire of each pair branching to the line springs of each jack in the series, one at each section of the switchboard, and terminating at one side of the line annunciator; the second wire of each of the said pairs being normally connected by means of the armature of a relay upon its back stroke, to the other side of said line annunciator; and a third wire branching first to the frames or test rings of each line jack in the series, and second, to a normally open contact adapted to be closed by said relay armature upon its forward stroke, and third, through the high resistance helices of said relay to ground; combined with the testing and connecting plugs and cords of the operator's keyboard apparatus, whereby a testing circuit is made within the central station, as set forth.

6. In a metallic circuit multiple switchboard system, two or more pairs of wires forming the signaling circuits from two or more substations, one side or wire of each pair branching to the line springs of each jack in the series one at each section of the switchboard, and terminating at one side of the line annunciator; the second wire of each of the said pairs being normally connected by means of the armature of a relay, upon its back stroke, to the other side of said line annunciator; and a third wire branching first to the frames or test rings of each line jack in the said series, and second to a normally open contact, adapted to be closed by said relay armature upon its forward stroke, and third through the high resistance helices of said relay to ground; combined with the testing and connecting plugs and cords of an operator's keyboard apparatus whereby a testing circuit is made from ground, central station battery, resistance and the sleeve side of the test plug of a connected pair, over the said third wire through the tip side of the testing plug and through the listening telephone to ground.

7. In a metallic circuit multiple switchboard system, a pair of wires forming the signaling circuit from a substation and passing through the several sections of the switchboard,—one of said wires branching to the line springs of the jacks upon said sections, both of said wires terminating in opposite sides of a line annunciator; a third wire having branches to the test rings of each of the said jacks and a ground at its outer end, provided also near said end with a normally open contact and including the high resistance helices of a relay or circuit changer; combined with means for operating the said relay or circuit changer to change the said signaling circuit to a talking circuit, consisting of the operator's answering and connecting plugs and cords having legged to the sleeve side thereof a grounded wire which includes a resistance and battery.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 1st day of July, 1892.

JAMES L. McQUARRIE.

Witnesses:
GEO. WILLIS PIERCE,
FRANK C. LOCKWOOD.