

J. J. O'CONNELL.

TELEPHONE EXCHANGE KEY BOARD APPARATUS.

No. 430,748.

Patented June 24, 1890.

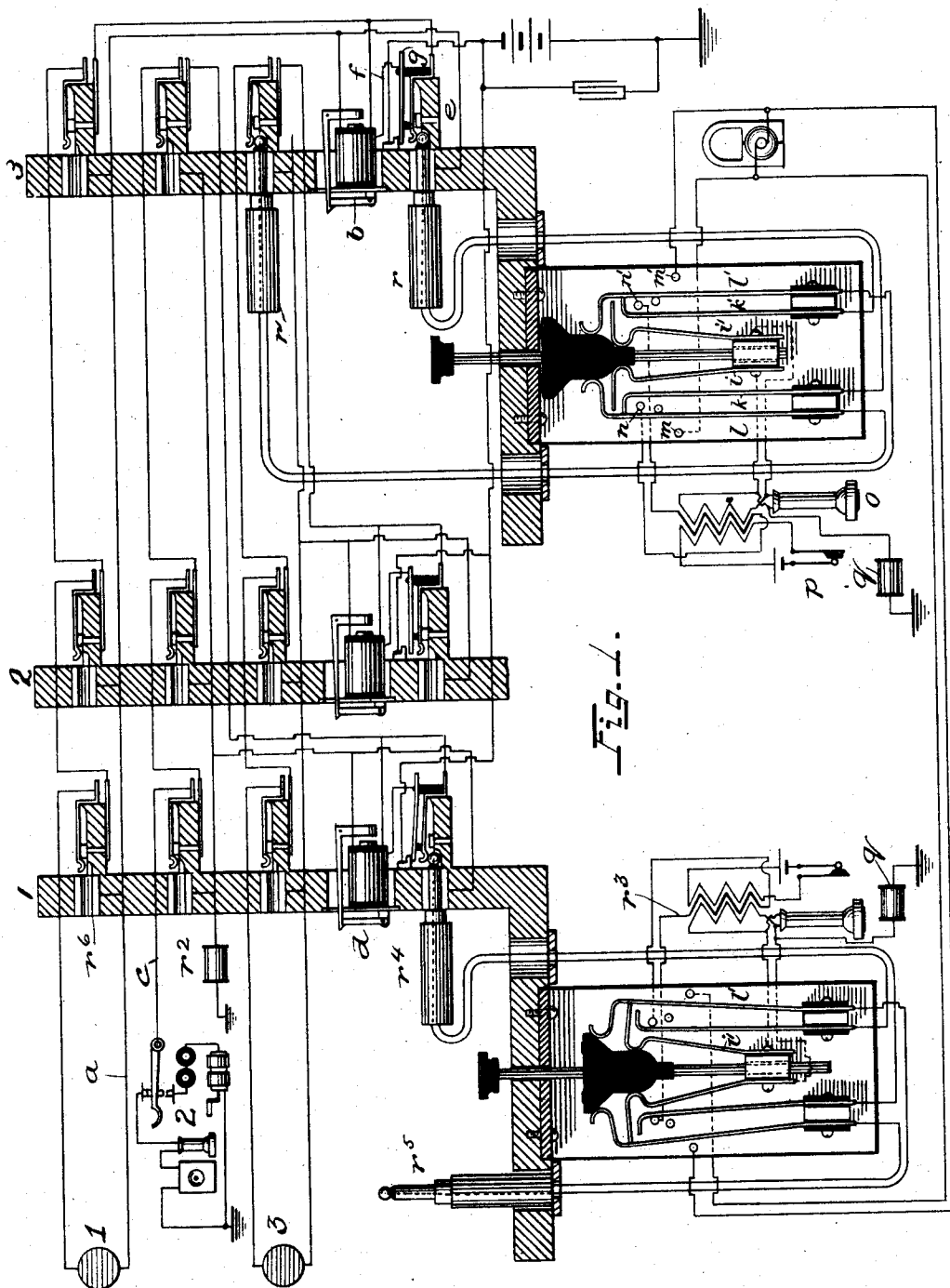


Fig. 1.

Witnesses.

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(No Model.)

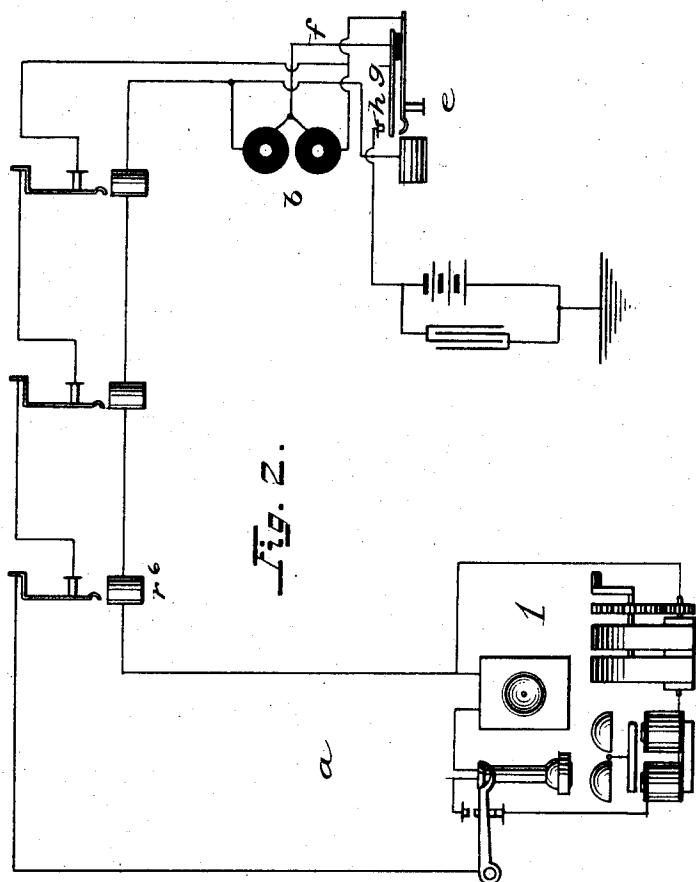
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# UNITED STATES PATENT OFFICE.

JOSEPH JOHN O'CONNELL, OF CHICAGO, ILLINOIS.

## TELEPHONE-EXCHANGE KEY-BOARD APPARATUS.

SPECIFICATION forming part of Letters Patent No. 430,748, dated June 24, 1890.

Application filed September 30, 1889. Serial No. 325,520. (No model.)

*To all whom it may concern:*

Be it known that I, JOSEPH JOHN O'CONNELL, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Key-Board Apparatus, (Case 8,) 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 telephone-exchange systems in which multiple switch-boards are employed, and is adapted for use in such systems employing both metallic and grounded or single telephone-lines connected with the same switch-boards. Such systems have sometimes been termed "mixed systems" of telephone-exchange.

Heretofore the circuit-connections of the telephone-lines have been run in various ways. Usually, however, the metallic circuits have consisted of a line extending from the subscriber's station through the spring and contact of each of the switches on each of the switch-boards, and from the contact of the switch on the last board through an individual annunciator, and thence back to the test-piece or tube of each of said switches of the line, and thence returning to the subscriber's station. The single or grounded telephone-lines have been run each from ground at the subscriber's station through the spring and contact of a switch on each of the boards, and thence through the individual annunciator of the line, and thence to the tubes or test-pieces of the switches, and thence through resistance to ground at the central office. It has been found convenient to provide an answering spring-jack switch in the circuit of each telephone-line upon the same board with the individual annunciator thereof, this answering-switch being the one at which the initial connection is made when a call is sent over the line to throw down the individual annunciator thereof.

My invention herein relates more especially to the key-board apparatus and the circuit-connections with the operator's telephone, and the means for connecting and disconnecting the test-battery with the telephone-line to cause battery-current to be pres-

ent at the test-pieces of a line when in use, and to be absent therefrom when the line is free.

I provide an individual annunciator of high resistance in each telephone-line, a branch from between the two coils of the annunciator extending to a spring provided upon the answering-switch, which spring is closed to a branch containing the test-battery when a plug is inserted in the answering-switch of the line. The circuits of the operator's telephone at each board are so arranged that when the answering-plug is inserted in the answering-jack of a line that has called said calling-line will be looped through a third winding of the induction-coil of the operator's telephone. The telephone is bridged across the strands of the cord of the other plug of the pair, which other plug may be termed the "test-plug," so that the circuit through the receiving-telephone will be completed at all times without the necessity of providing for crossing the said strands by means of a double metallic heel resting upon a metallic plate, as has been done sometimes heretofore. When the loop-key is operated to bring the operator's telephone into communication with the calling subscriber, the test-battery is not connected with the test-plug of the pair, and hence there will be no false signals or false tests indicated when the operator proceeds to test the line called for. The operator upon receiving the order for another line immediately applies the tip of the test-plug to the line called for, and if the line tests free immediately inserts the test-plug into the switch of the line thus tested, thus looping the two lines together. She then depresses the plunger of the loop-key of the pair of cords a second step, thereby sending current over the line called for. The insertion of the answering-plug into the answering spring-jack of any line throws the test-battery to the center of the coils of the annunciator of the line, so as to make the line test busy. The object of putting the connection with the test-battery between the two coils of the annunciator is to balance the different sides of the line. The insertion of the test-plug into the switch of the line called for connects the test-battery also with the called line, the test-battery being connected to both

sides of said line through both strands of the cord of the test-plug.

My invention is illustrated in the accompanying drawings, in which—

5 Figure 1 is a diagram showing three telephone-lines, two having metallic circuits and one having a grounded circuit, each connected with three different switch-boards, together with the operator's apparatus at two  
10 of the switch-boards. Fig. 2 is a diagram illustrative of the connections of a telephone-line with the individual annunciator thereof and the branch connection from between the coils of the annunciator to a spring upon the  
15 answering-switch, together with the ground branch containing the test-battery with which said spring is closed when a plug is inserted in the answering-switch and a metallic-circuit subscriber's outfit.

20 Like parts are indicated by similar letters of reference in the different figures.

The metallic - circuit telephone-line *a* extends from the switch at station 1 to the central office, and thence through the spring and  
25 contact of a spring-jack switch on each of the switch-boards 1 2 3, and from the contact of the switch on the last board through the individual annunciator *b*, and thence to the test-pieces of each of said spring-jack switches,  
30 and thence back to station 1.

The telephone-line *c* extends from ground at station 2 to the central office, and is there connected in the same manner as line *a* through the spring and contact of a different  
35 switch on each of the switch-boards, and thence through an individual annunciator *d*, and thence with the test-pieces of each of the switches of the line, and thence through resistance to ground instead of returning to  
40 station 2. The answering-switch *e* of line *a* has its spring connected with a branch coming from the contact of the switch on the last board, while the frame of said answering-switch is connected with a branch coming  
45 from the return or test portion of the said line *a*. A wire *f* connects from between the coils of the annunciator *b* to the spring *g* of the answering-switch *e*, this spring being insulated from the other portions of the switch  
50 and adapted to be closed against a contact *h* of the ground branch containing the test-battery, said spring *g* being thus closed when a plug is inserted in the answering-switch.

I will now describe the loop-key or key-board-switching device, which is shown as  
55 consisting of six springs and a plunger adapted to be inserted between the springs, said plunger when inserted one step serving to bring the telephone into connection with the cord of  
60 the answering-plug, leaving the test-battery disconnected from the cords of the other plug of the pair—that is to say, the test-plug. Inserting the plunger a second step serves to throw current onto the cord of the test-plug—  
65 that is to say, serves to send signaling-current over the line wanted when the test-plug is inserted in a spring-jack switch of the line

thus called. These six springs may be considered as consisting of three pairs, the two inner  
70 springs *i i'* being the telephone-springs, the two intermediate springs *k k'* being the springs of the answering-plug, and the other springs *l l'* being the terminals of the different strands of the cord of the second loop-plug or test-plug of the pair. The contacts *m m'* lead to  
75 the different poles of the generator. Contacts *n n'*, when the intermediate springs *k k'* are closed thereon, complete a circuit through a third winding of the induction-coil of the operator's telephone outfit.

80 The receiving-telephone *o* is bridged across the cords of the answering-plug, and may be of a resistance of, say, two hundred ohms, so as not to cut down the induced currents sent over the called subscriber's line by transmitter  
85 *p* when the test-plug is inserted in the spring-jack switch of a line to loop said line onto the strands of the cord of said test-plug. A branch to ground through resistance-coil  
90 *q* is provided, so that the strand of the test-plug connected with the tip thereof may find circuit to ground when the tip of the plug is applied to the test-piece of a switch in the act of testing.

At board 3 I have shown the telephone-line  
95 *a* of station 1 and the line of station 3 looped together by the pair of loop-plugs *r r'*. It will be seen that these two lines are united in metallic circuit practically free from resistance. The circuit may be traced through  
100 the loop-switch from the tip of plug *r* to spring *k'*, and thence to spring *l'*, and thence to the tip of plug *r'*. The other side of the circuit may be traced from the sleeve of plug *r'* to the spring *k*, and thence to spring *l*, and  
105 thence to the sleeve of plug *r*. The wire *f*, which connects with the test-battery, is connected between the two coils of the annunciator *b*, and hence the current of the battery will divide in different directions through  
110 said coils. Thus the balance of the circuit is maintained when the busy test is on. The resistance *r<sup>2</sup>*, included in the line *c*, should be so great as to prevent any considerable loss of current from the test-battery when  
115 line *c* is connected with another, and yet the resistance should not be so high as to prevent the subscriber at station 2 from sending current over his said line *c* to operate the individual annunciator *d* thereof.  
120 The transmitter *p*, it will be seen, is included in the primary circuit of the induction-coil of the telephone. The telephone-receiver is included in the secondary winding of the induction-coil, but bridged across the same, as  
125 before described. The third winding of this induction-coil has its terminals at contacts *n n'*, these terminals *n n'* being connected with the intermediate springs *k k'* when the plunger is depressed, thus looping the calling subscriber's line into the circuit of this third  
130 winding when the plunger is depressed the first step. Thus at the first board the plunger is shown thus depressed, and the tele-

phone-line  $c$  is connected through the third winding  $r^3$  of the induction-coil of the telephone set at board 1. The test-battery connection was thrown on to said line  $c$  when answering-plug  $r^4$  was inserted in the answering spring-jack of line  $c$ , as shown. The telephonic connection with the operator's telephone being, however, through a third winding of the induction-coil, the test-battery will not be connected with the cord of the test-plug  $r^5$  at board 1. Therefore the operator at board 1 having received the call from line  $c$ , we will say, for connection with line  $a$ , will proceed to test line  $a$  by applying the tip of plug  $r^5$  to the test-piece  $r^6$  of the spring-jack switch of line  $a$  upon board 1. Now this line  $a$  is shown connected at the last board, and hence current will be present at test-piece  $r^6$ . Therefore on touching the tip of plug  $r^5$  to test-piece  $r^6$  current will be directed through the strand of the cord of plug  $r^5$ , connecting with the tip thereof to the outer spring  $l'$  of the switch, thence to telephone-spring  $i'$  thereof, and thence through the telephone, and thence through resistance-coil  $g$  at board 1 to ground. The operator, listening at the telephone, will hear the sound caused by the current, and will hence know that the line is in use.

It should be observed that the loop-key or key-board-switching device is operated by a single plunger, said plunger being capable of assuming three positions, the first position being that shown at board 3, the second position being that shown at board 1, and the third position being that which is assumed when the plunger is depressed farthest, so as to bring the outer springs against the generator-contacts to send current over a line with which the test-plug has been connected.

I have shown a condenser in a shunt-circuit around the test-battery. This feature of my system I have described and claimed in my application, Serial No. 325,519, filed simultaneously herewith.

Instead of the resistance  $r^2$  in the grounded portion of each single telephone-line, I have used a condenser of about a microfarad in capacity and from between the coils of the individual annunciator  $d$ , I have provided a ground connection of about three hundred ohms, resistance. When the single circuit is thus modified, the subscriber rings through one coil only of his individual annunciator. The condenser is of sufficient capacity to permit of talking through the same to ground.

My invention admits of various other modifications which will readily suggest themselves to those skilled in the art, and I do not therefore limit myself to the details of construction shown.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. The combination, with a telephone-line containing an individual annunciator of high resistance and an answering spring-jack

switch upon one of several boards with which the line is connected, of a connection from between the coils of the annunciator to a spring upon the answering spring-jack, and a connection with a battery upon which the said spring is closed when connection is made with the line at the answering-switch, whereby the line is made to test busy and the two sides thereof balanced, substantially as and for the purpose specified.

2. Two telephone-lines, each extending to two or more switch-boards and connected together for conversation through a pair of loop plugs and cords, one of said plugs being inserted in the answering-switch of one of the lines and the other in a spring-jack switch of the other line upon the same board, in combination with an annunciator included in the circuit thus formed, and a branch circuit to ground through a battery from between the two coils of the annunciator.

3. The test-battery branched to different contacts, one near the special test-circuit-closing spring of each of several answering spring-jack switches of different telephone-lines connected each with two or more switch-boards, and an annunciator in each of said lines, and connections from between the coils thereof, respectively, to the different test-circuit springs, substantially as and for the purpose specified.

4. The combination, with the calling subscriber's circuit connected with two or more switch-boards, of a loop-plug inserted in the answering-switch thereof, the cord of said loop-plug being connected through a third winding of the operator's telephone induction-coil and a test-battery in a ground-circuit branched from said telephone-line, whereby telephonic communication is established between the subscriber and the operator, while the battery-current is prevented from traversing the circuit containing the operator's receiving-telephone.

5. The combination, with the key-board-switching device consisting of the six circuit-changing springs, of the generator-contacts in co-operative relation with two of said springs, which are connected to the test-plugs, and the contacts with the third winding of the telephone induction-coil, and a plunger mounted between the free ends of said springs and adapted to be inserted two steps, one step after the other, substantially as and for the purpose specified.

6. A key-board-switching device consisting in the combination of the two central telephone-springs and two intermediate springs with two outside springs mounted in the same plane, contacts for the third winding of the induction-coil of the operator's telephone, one outside each of the intermediate springs, and a plunger mounted between the free ends of said springs and adapted to be inserted one step to close the telephone-springs to the outside springs, respectively, at the same time separating the intermediate springs from their

normal connection with the outside springs, respectively, and allowing said intermediate springs to close on the contacts of the third winding of the induction-coil, substantially  
5 as and for the purpose specified.

7. Two telephone-lines connected telephonically with an operator's outfit at the central station, one of said telephone-lines being included in the third winding of the induction-  
10 coil of the operator's telephone and the other

line being connected through the receiving-telephone and the secondary winding of the said induction-coil.

In witness whereof I hereunto subscribe my name this 26th day of September, A.D. 1889. 15

JOSEPH JOHN O'CONNELL.

Witnesses:

GEORGE P. BARTON,  
ELLA EDLER.