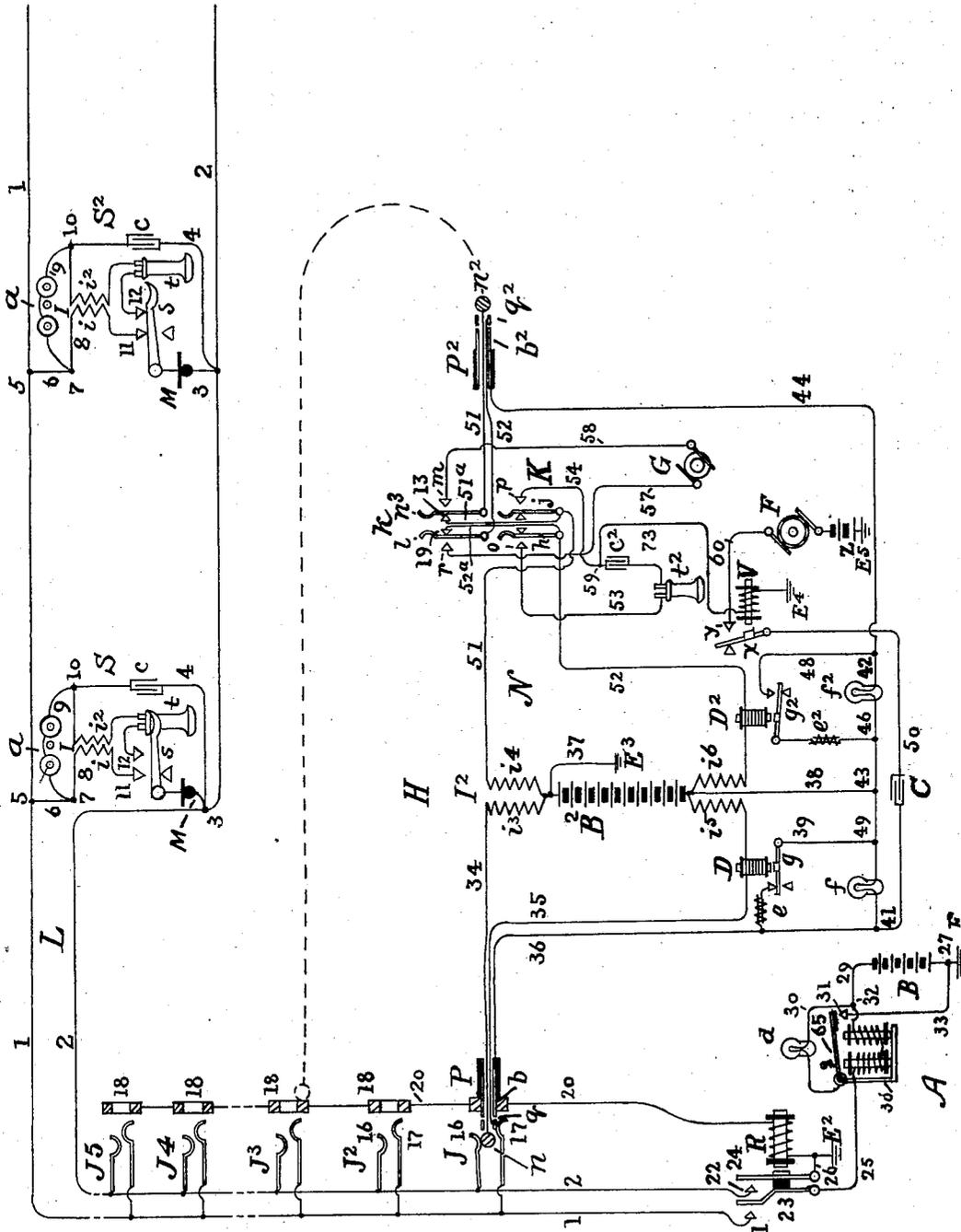


J. J. O'CONNELL.

BUSY TEST APPARATUS FOR TELEPHONE SWITCHBOARDS.

APPLICATION FILED MAR. 16, 1903.

NO MODEL.



WITNESSES:

*Frank C. Lockwood.*  
*Joseph Alsaty*

INVENTOR.

*Joseph J. O'Connell*  
 BY *Thomas Lockwood*

ATTORNEY.

# UNITED STATES PATENT OFFICE.

JOSEPH J. O'CONNELL, OF CHICAGO, ILLINOIS, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

## BUSY-TEST APPARATUS FOR TELEPHONE-SWITCHBOARDS.

SPECIFICATION forming part of Letters Patent No. 736,002, dated August 11, 1903.

Application filed March 16, 1903. Serial No. 148,026. (No model.)

Patent No. 736,002.

*To all whom it may concern:*

Be it known that I, JOSEPH J. O'CONNELL, residing at Chicago, in the county of Cook and State of Illinois, have invented certain improvements in Busy-Test Apparatus for Telephone-Switchboards, of which the following is a specification.

The present invention relates to the application of the common battery or centralized source of energy in connection with telephone-switchboards to party-lines, in which a plurality of substations are located upon one pair of conductors forming a circuit between said substations and the central station. Ordinarily such party-lines are provided at the answering-section of the switchboard at the central station with a line-signal, a call-answering switch-socket and a call-connecting switch-socket, and in a multiple switchboard with a call-connecting switch on each of its sections, and one number is given to the party-line on the switchboard. Each substation, however, is individualized in a directory by a prefix to the line-number—as, for instance, number 55 circuit having three stations thereon are known as 55-2, 55-3, and 55-4, which are all represented as previously stated by one answering switch-socket and the connecting switch-sockets. It is now proposed to provide a line-signal and an answering switch-socket upon one section of the switchboard and as many connecting switch-sockets upon each of the switchboard-sections as there are stations on the party-line. For instance, if there are ten stations upon a line there will be ten connecting switch-sockets, each having an independent number which is applied to each station, so that all the incoming calls from the several line stations are answered upon one section of the switchboard, while the outgoing calls to the several stations on the line are made individual from all the sections. In carrying out this arrangement of supplying a switch-socket for each subscriber on a party-line it becomes necessary under certain circumstances to provide an additional busy test—as, for instance, when one subscriber on the circuit wishes to speak with a second

subscriber on the same circuit, the call being made and the answering-plug of the operator inserted into the answering switch-socket of the circuit, in reply with the present means at her disposal when the operator applies the tip of the test-plug to the ring of the switch-socket of the called-for substation the usual busy-test signal will be heard by the operator and so far as her means of testing are concerned the circuit of the desired subscriber is busy.

My invention addresses itself to the provision of means whereby when a call is made and the operator proceeds to make the test to ascertain whether the circuit is busy or not, as referred to, an additional and distinctive audible test is produced, which signifies to the operator that she is dealing with a party-line and that although she receives the busy signal common to all circuits yet the supplemental test accompanying the same enables her to determine that the circuit is not busy except in so far as it becomes so by the insertion of the plug to answer the call made over the line itself. In the particular embodiment of the invention, hereinafter described in detail, the means referred to consist, essentially, of a relay in a normally open grounded branch from the listening-key or tip-strand of the test-plug of the cord-circuit, which is adapted to close a special-test circuit, including a tone or other audible device, through a condenser to the sleeve-strand of said cord-circuit of the answering-plug when inserted in the answering switch-socket of the calling party-line circuit and when the tip of the testing-plug is brought into contact with the corresponding ring of the switching-socket, all of which I will now proceed to describe, and point out in the claims appended hereto.

In the diagram which forms a part of and illustrates the specification, L represents a telephone-circuit connecting a central station H with the substations S and S<sup>2</sup> by means of the conductors 1 and 2, which are extended beyond the station S<sup>2</sup> to indicate that other stations may be associated therewith. Two stations are, however, sufficient to illustrate the invention, although it is intended to pro-

vide for ten stations. At stations  $SS^2$  a bridge may be completed from point 5 on conductor 1 by wires 6 and 8 winding  $i$  of induction-coil I, upper switch-contact 11, hook switch-lever  $s$ , and transmitter M to point 3 on conductor 2, the call-bell  $a$  being in branch 9 between points 7 and 10, and the receiver  $t$  in series with the winding  $i^2$  of the coil and condenser in the short circuit 4, set off from the main line between the stop 12 and the point 3 on conductor 2. At the central-station end the circuit L is provided with the answering switch-socket or spring-jack J, and the companion or calling switch-sockets  $J^2$  and  $J^3$ , each having the terminal switch-springs 16 and 17. The socket  $J^2$  represents the substation S and the socket  $J^3$  the substation  $S^2$  on the section of switchboard indicated.

$J^4$  and  $J^5$  are spring-jacks representing the stations S and  $S^2$  upon a second section of the switchboard, and they may be multiplied to as many sections as the board contains, in a well-known manner, there being, as previously stated, an individual companion or calling socket for each of the several substations of the circuit. The main conductors 1 and 2 extend to the contact-stops 21 and 22, respectively, of the spring-arms 23 and 24, carried by the armature of the cut-off relay R, the former spring 23 being united by conductor 25 to the winding of relay A and thence by conductor 29 to the source of current B and to ground E, while the other spring 24 connects by wire 26 directly to earth at  $E^2$ .

The test-rings 18 of the several switch-sockets are joined conductively to one another by the conductor 20, which extends through the winding of the cut-off relay R also to the earth connection  $E^2$ . The line signal-lamp  $d$  is, as usual, in a short or local circuit 30 of battery B, branching at a point 32 from conductor 29 and leading through said signal  $d$  to the armature 65 of the line-relay A, and on the excitement of said relay and the consequent attraction of its armature by way of the contact-point or stop 31 and conductor 33 to the other pole of the battery.

N represents an operator's cord-circuit, containing or closely associated with the characteristic features of the invention. It terminates in the switch-plugs P  $P^2$ , whose respective tip-contacts  $n$  and  $n^2$  are united through the conductors 34 and 51 and the part-windings  $i^3$   $i^4$  of the induction-coil I<sup>2</sup>, and whose ring-contacts  $q$   $q^2$  are connected to the windings  $i^5$  and  $i^6$ , respectively, of the said induction-coil I<sup>2</sup> by the conductors 35 and 52, while the sleeve contact-pieces of said plugs  $b$   $b^2$  are connected by their respective conductors 36 and 44 and the common conductor 38 to the ungrounded pole of the bridged battery B<sup>2</sup>, provided by conductor 37 with the usual ground connection  $E^3$ . Supervisory signals  $f$   $f^2$ , associated with the plugs P  $P^2$ , respectively, are connected in the local-circuit

conductors 36 and 44 and adapted to be shunted by the armatures  $g$   $g^2$  of the supervisory relays D  $D^2$  of the conductors 35 and 52, all in a common and usual manner. The call-generator G and the operator's telephone are arranged to be switched in between the conductors 51 and 52 by the respective keys  $k$  and K, and as their circuits are in the invention they will now be described in detail. The normal circuit from the tip  $n^2$  of the plug  $P^2$  extends by way of conductor 51, spring  $n^3$  of call-key  $k$ , its inner contact-stop 13 and wire 51<sup>a</sup> to the heel of spring  $j$  of the listening-key K, from which the said conductor 51 continues to the winding  $i^4$  of the coil I<sup>2</sup>, and the normal circuit from the ring contact-piece  $q^2$  of the said plug is by conductor 52, spring  $l$  of the calling-key, its inner stop 19 and wire 52<sup>a</sup> to the heel of the second spring  $h$  of the listening-key and from thence to the winding  $i^6$  of the said coil. When the springs of the calling-key  $k$  are separated from the stops 19 and 13 and brought into contact with their outer stops  $r$  and  $m$ , the conductors 51 and 52 are severed, being opened toward the windings of the induction-coil, and at the same time the call-generator connected, as shown, to the latter stops by the conductors 57 and 58 is brought into the circuit over which the call is to be sent, (the plug  $P^2$  being supposed to be in a socket of such circuit,) and when the springs  $h$  and  $j$  of the listening-key are brought into connection with their outer stops  $o$   $p$  the telephone  $t^2$ , being connected on one side by conductor 53 to the stop  $o$  and on the other side by the conductor 54, including condenser  $c^2$ , to the outer stop  $p$ , is placed in shunt relation to or bridged between the conductors 51 and 52, so that the ordinary busy test may be made.

To provide effective means for applying the special and supplementary busy test and for determining thereby unmistakably that a party line over which a call has been received at the central station is otherwise engaged or disengaged, as the case may be, there is provided a conductor 73, extending to earth  $E^4$  from a point 59 on the telephone-loop 53 between the condenser  $c^2$  and the outer contact  $p$  of key K and a relay V included in said conductor. There is also a special test-signal branch circuit 50 arranged between the earth connection  $E^5$  and a point 41 on the local cord conductor 36, associated with the answering-plug P, which branch circuit contains the condenser C between point 41 and the armature-contact  $x$  and the rotary or other tone-test circuit-breaker or continuous interrupter F and the battery  $z$  between the earth-terminal  $E^5$  and the fixed relay-contact  $y$ , and is controlled by the relay V, passing thus through the switch-contacts  $xy$  thereof. In the operation of these circuits let it be supposed that substation  $S^2$  calls the central station by removing the receiver  $t$  from the hook-switch  $s$ , thus closing the main circuit L by establish-

ing contact between the switch-lever and its upper stop 11. Current from battery B flows in the circuit thus completed through relay A, conductors 25 and 1, the bridge at the substation between point 5 of main conductor 1, and point 3 on conductor 2, through conductors 6 and 8, the induction-coil winding *i*, point 11, switch-lever *s*, and transmitter M, main conductor 2, and ground connection E<sup>2</sup>, and thence to the other pole of the battery at 27 by way of the battery ground connection E. The line-relay A is excited by the current in the main circuit and attracting its armature 65 brings the same into contact with the forward stop 31, which closes the local circuit of the line-signal *d* through the battery B, conductor 29, conductor 30, signal *d*, armature 65, contact-stop 31, and conductor 33, producing a flow of current therein and illuminating the lamp *d*, thereby giving the call-signal. In response to the signal, which, with the answering switch-socket is upon one section of the switchboard, the operator inserts the answering-plug P in the answering switch-socket J and the cut-off relay R operates in the customary manner, the line-signal being cut off and extinguished as current from battery B<sup>2</sup> circulates in the local circuit extending through conductors 38 and 36, sleeve of plug P, conductor 20, relay R, and ground E<sup>2</sup> to ground E<sup>3</sup>. At the same time current from said battery goes out over the circuit L by conductor 35, plug P, and conductor 1 to the substation, returning by conductors 2 and 34. The operator receives the connection order in the usual manner, her telephone being connected with the circuit by the operation of the listening-key K. She then proceeds to make the test, and as the calls are made by giving the number of the subscriber wanted the operator is not informed whether the person wanted is upon the same circuit as the calling subscriber or upon another circuit, and therefore if the switch-socket J<sup>3</sup> of the same line as that which originated the call is found to bear the number called for the test is made by touching the tip of the plug P<sup>2</sup> to the ring 18 of such socket, the operator's telephone being still bridged to the cord-strands. Now current is circulating, as previously described, in the local or cut-off relay circuit, composed of the conductors 38, 36, and 20, and from ground E<sup>2</sup> to ground E<sup>3</sup>, and a potential differing from that of the earth is thereby impressed upon the test-rings 18. When, therefore, the tip of the plug P<sup>2</sup> touches the ring 18 of socket J<sup>3</sup>, a readjustment of current takes place, an impulse flowing through the receiver-loop by way of plug-tip *n*<sup>2</sup>, conductor 51, ringing-key spring *n*<sup>3</sup>, conductor 51<sup>a</sup>, listening-key spring *j*, outer contact-stop *p* thereof, conductor 54, condenser *c*<sup>2</sup>, receiver *h*<sup>2</sup>, conductor 53, ringing-key contact-stop *o*, spring *h*, conductor 52, battery B<sup>2</sup>, and ground E<sup>3</sup>, producing the usual click in the said operator's telephone, and indicating the busy or engaged condition

of the line. This, however, would occur whether the line under test were the same line as that originating the call or another one, since the presence of the plug P in the answering-socket of a line, which has called, produces the conditions underlying the foregoing test system. The said test, therefore, is insufficient in the case where connection with one station of a party line is desired by another on the same line, for the reason that the wanted line would inevitably be reported busy and therefore inaccessible were such test alone relied upon. By my invention an additional and absolute test is provided, showing that the busy condition determined is merely a condition established by the answering of a call on the same circuit as that of the station wanted and that such busy or engaged condition is, under existing circumstances, to be disregarded. The listening-key K being as described in its operative position and the telephone *h*<sup>2</sup> thereby switched to the cord strands, a closed circuit is established when the tip of plug P<sup>2</sup> is touched to the testing of socket J<sup>3</sup>, through conductor 73 branching from the telephone loop at point 59 and relay V, to earth at E<sup>4</sup>, and current flowing from the said test-ring will excite the said relay V, which will attract its armature and establish contact between the switch-points *x* and *y*. The tone-test interrupter F and its battery *z* are thus brought into connection through wires 60, 50, and 36 and plug P with all of the several test-rings of the line whose call has been answered by the insertion of plug P, and which is now being tested by the application of the tip of plug P<sup>2</sup> to the ring 18 of socket J<sup>3</sup>, and since the two plugs belong to the same cord the musical tone or buzz thus impressed upon the test-circuit is heard in the receiver. The operator is thus informed that the called-for subscriber is on the same circuit with the calling subscriber and that the connection may be completed notwithstanding the manifestation of the ordinary busy test. Accordingly she inserts the plug P<sup>2</sup> into the connecting spring-jack J<sup>3</sup>, bearing the number of the substation called for and by means of the call-generator G calls up the said substation, and when the subscriber there responds conversation between the calling and called substations may be carried on. The manifestation of the special test to indicate the character of the engaged condition of the tested line depends altogether upon the fact that both calling and called substations are on the same line, and the consequent fact that the test-ring where the answering-plug is inserted is in direct connection by conductor 20 with the test-ring of the socket, which is touched by the tip *n*<sup>2</sup> of the companion plug P<sup>2</sup> of the same cord.

The invention is of course susceptible of other embodiments than that herein particularly shown and described.

What is claimed is—

1. The combination with a polystation telephone - line connecting with a plurality of switch-sockets or jacks at a central station, of subscribers' telephonic apparatus connected with said line and adapted to respond only to calling-signals sent from the central station, a cord connection for connecting the line-terminals of one switch-socket or jack with those of another switch-socket or jack at the central station, and signaling means for giving a distinctive signal when both the socket with which answering connection is made and that with which calling connection is desired are connected to the polystation-line.
2. The combination with a polystation telephone - line connecting with a plurality of switch-sockets or jacks at a central station, of subscribers' telephonic apparatus connected with said line and adapted to respond only to calling-signals sent from the central station, a cord connection for connecting the line-terminals of one switch-socket or jack with those of another switch-socket or jack at the central station, busy-test signaling means for giving a busy-test signal when a second telephone with which it is desired to connect the polystation-line is engaged, and signaling means for giving a distinctive signal when both the socket with which answering connection is made and that with which calling connection is desired are connected to the polystation-line.
3. The combination with a polystation telephonic line connecting with a plurality of switch-sockets or jacks at a central station, of a cord connection and its plugs for connecting the line-terminals of one switch-socket or jack with those of another switch-socket or jack at the central station; and signaling means rendered operable upon insertion of a plug of the cord connection into the socket of a calling polystation-line for giving a distinctive signal when the socket with which calling connection is desired belongs also to said calling polystation-line.
4. The combination with a polystation telephone - line connecting with a plurality of switch-sockets or jacks at a central station, of a cord connection for connecting the line-terminals of one switch-socket or jack with those of another switch-socket or jack at the central station; central - station operator's telephonic apparatus associated with the cord connection; and signaling means for giving a distinctive audible signal in the central-station operator's telephone when both the socket with which answering connection is made and that with which calling connection is desired represent the said polystation-line.
5. The combination with a polystation telephone - line connecting with a plurality of switch-sockets or jacks at a central station, of a cord connection for connecting the line-terminals of one switch-socket or jack with those of another switch-socket or jack at the central station; central - station operator's telephonic apparatus associated with the cord connection; busy - test signaling means for giving a busy-test signal when a second telephone with which it is desired to connect the polystation-line is engaged; and signaling means for giving a distinctive audible signal in the central-station operator's telephone when both the socket with which answering connection is made and that with which calling connection is desired are sockets of the said polystation-line.
6. The combination with a polystation telephone-line connecting with a central station, provided upon the switchboard with an answering-jack, and with connecting-jacks equal in number to the substations on the line, each jack representing a particular station; of a cord or linking circuit connection having an answering-plug and a testing-plug; means for placing usual testing conditions upon the test-rings of the connecting-jacks to be manifested on the application of the test-plug thereto; and means for superposing supplementary testing conditions upon the said jacks, as set forth.
7. In a telephone-exchange system, the combination of a main telephone-circuit, extending from a plurality of substations to a central station; and a switchboard at said central station to which the said main circuit is connected, and on which it is represented by an answering switch-socket or jack, and a number of connecting or calling switch-sockets one for each substation; with a special busy-test system comprising a normally open test-circuit formed of the test-rings of the several switch-sockets of said main circuit conductively united with one another, the answering and companion plugs of the same connection-cord, and their respective associate cord conductors; and a distinctive or tone signal producing device contained in said test-circuit; whereby it may be determined whether the said main circuit when tested and found "busy" be engaged merely because of the call of one for another of its own substations or otherwise; substantially as set forth.
8. In a telephone-exchange system, the combination of a main telephone-circuit extending from a plurality of substations to a central station; and an answering jack or switch-socket, and a number of connecting or calling switch-sockets one for each substation, mounted on a switchboard at said central station, the same being connected with and representing the said main circuit; with a special busy-test circuit including a tone or distinctive signal device, the said test-circuit being normally open and adapted to be closed for the manifestation of said distinctive signal, only when the answering switch-plug placed in the answering switch-socket, and the companion plug applied to the test-ring of a connecting-socket of said main circuit to test the same

are members of the same pair, or belong to the same connection-cord; substantially as described.

9. The combination in a telephone-exchange switchboard apparatus, of a main polystation telephone-circuit connecting with a central station; a switchboard apparatus having an answering-jack of said main circuit at one section thereof, and a plurality of connecting-jacks of said main circuit equaling in number the number of substations connected with such main circuit at each section thereof; and the usual busy-test apparatus adapted to manifest a busy-signal when any switch-plug is in a socket of the line tested; with auxiliary or supplementary busy-test apparatus adapted to manifest a distinctive busy signal when the switch-plug inserted to produce the engaged condition of said polystation-circuit and the switch-plug applying the test, are the two plugs of the same pair, or of the same connection-cord; substantially as set forth.

10. The combination in the switch apparatus of a telephone-exchange, of a main polystation telephone-subscriber's circuit; a switchboard having an answering-socket for said circuit on one side of its sections and a plurality of switching or connecting switch sockets one for each substation of said circuit on all sections; and the usual and ordinary busy-test system to determine whether such line when called for is at liberty; with means for ascertaining when such line called for is reported as being already engaged, whether such engagement is because of the call of one for another of its own substations, or otherwise; substantially as set forth.

11. The combination of a polystation telephone-line extending between substations and a central-station switchboard and provided upon one section of said switchboard with a call-signal and answering jack or socket, and upon all sections with the same number of connecting-sockets that there are substations on the line; with a switch-cord or switch-circuit connection having an answering-plug and a testing companion plug; means associated with the answering-plug for impressing the usual busy-test potential upon the test-rings of the several connecting-sockets, and with the test-plug for the manifestation of a test-signal due to said potential when said test-plug is applied to said test-rings; and a normally open auxiliary test-circuit including a distinctive or tone-producing signal device and adapted to be completed only through both switch-plugs of the same pair or cord, and when the answering-plug is inserted in one jack of said polystation-line, and the tip of the testing or companion plug applied to the test-ring of another switch-socket of the same line; substantially as set forth.

12. In combination with a multiple-station telephone-line connecting with a central station, provided upon one section of the switchboard with a line-signal and answering-jack,

and upon all the sections with the same number of connecting-jacks as there are stations on the line, one jack in each section representing a particular station of a cord or switch-circuit connection having an answering-plug and a testing-plug; means associated with said cord for placing testing conditions upon the connecting-jacks adapted to produce the usual simple signal in the operator's receiving-telephone in response to the application of the test-plug thereto; and means for superposing supplementary testing conditions upon the said jacks and of producing a distinctive signal thereby in said receiver, substantially as set forth.

13. The combination in a central telephone-switching system, of a polystation main telephone-line; a switchboard with which the same connects, there being a call-signal device and an answering-jack for said line on one section of the switchboard and a plurality of connecting-jacks equal in number to the number of the substations of said main line on all sections; and the usual busy-test apparatus to determine the engaged or disengaged condition of said main line when called for; with an auxiliary or supplementary and distinctive test system comprising conductively-united test-rings of the several switch-sockets of said main line, an answering switch-plug and a local-circuit conductor attached thereto and adapted to connect with the test-ring of the answering switch-socket of said line when said plug is inserted therein, a branch conductor extending to earth from said local-circuit conductor, a tone or distinctive signal producing device connected in said branch conductor, the test-plug adapted to have its tip conductor brought into contact with any one of said test-rings, an operator's telephone-loop adapted for connection between said tip conductor and a suitable return-conductor, and a relay in an earth branch from said telephone-loop, controlling the said branch conductor containing the distinctive-signal-producing device, and receiving current for its operation through said tip conductor from the test-rings of a line tested, only when such line is busy; substantially as set forth.

14. The combination in a telephone-exchange system, of a telephone-circuit extending between a plurality of substations and a switchboard at a central station, the same being provided upon one section of said switchboard with an answering switch-socket, and on each section of said switchboard with as many connecting switch-sockets (each having a test contact) as there are substations on said circuit; a switch-cord or switch-circuit connection with a call-answering switch-plug at one end and a companion or testing plug at the other; means for manifesting the ordinary busy-test signal when the tip contact of the testing-plug of said switch-cord is applied to the test contact of said substation-

5 circuit while any of the switch-sockets there-  
of at any switchboard-section is occupied by  
a switch-plug; and means as indicated, for  
the substantially simultaneous manifesta-  
tion of a distinctive busy signal when the  
said socket occupying switch-plug and said  
testing-plug are respectively the answering  
and companion plugs of the same switch-cord.

In testimony whereof I have signed my  
name to this specification, in the presence of 10  
two subscribing witnesses, this 24th day of  
February, 1903.

JOSEPH J. O'CONNELL.

Witnesses:

ARTHUR D. WHEELER,  
LEVERETT THOMPSON.

Correction in Letters

736  
002

It is hereby certified that in Letters Patent No. 736,002, granted August 11, 1903,  
upon the application of Joseph J. O'Connell, of Chicago, Illinois, for an improvement  
in "Busy-Test Apparatus for Telephone-Switchboards," an error appears in the printed  
specification requiring correction, as follows: In line 27, page 5, the word "side"  
should be stricken out; and that the said Letters Patent should be read with this  
correction therein that the same may conform to the record of the case in the Patent  
Office.

Signed and sealed this 25th day of August, A. D., 1903.

[SEAL.]

E. B. MOORE,  
*Acting Commissioner of Patents.*