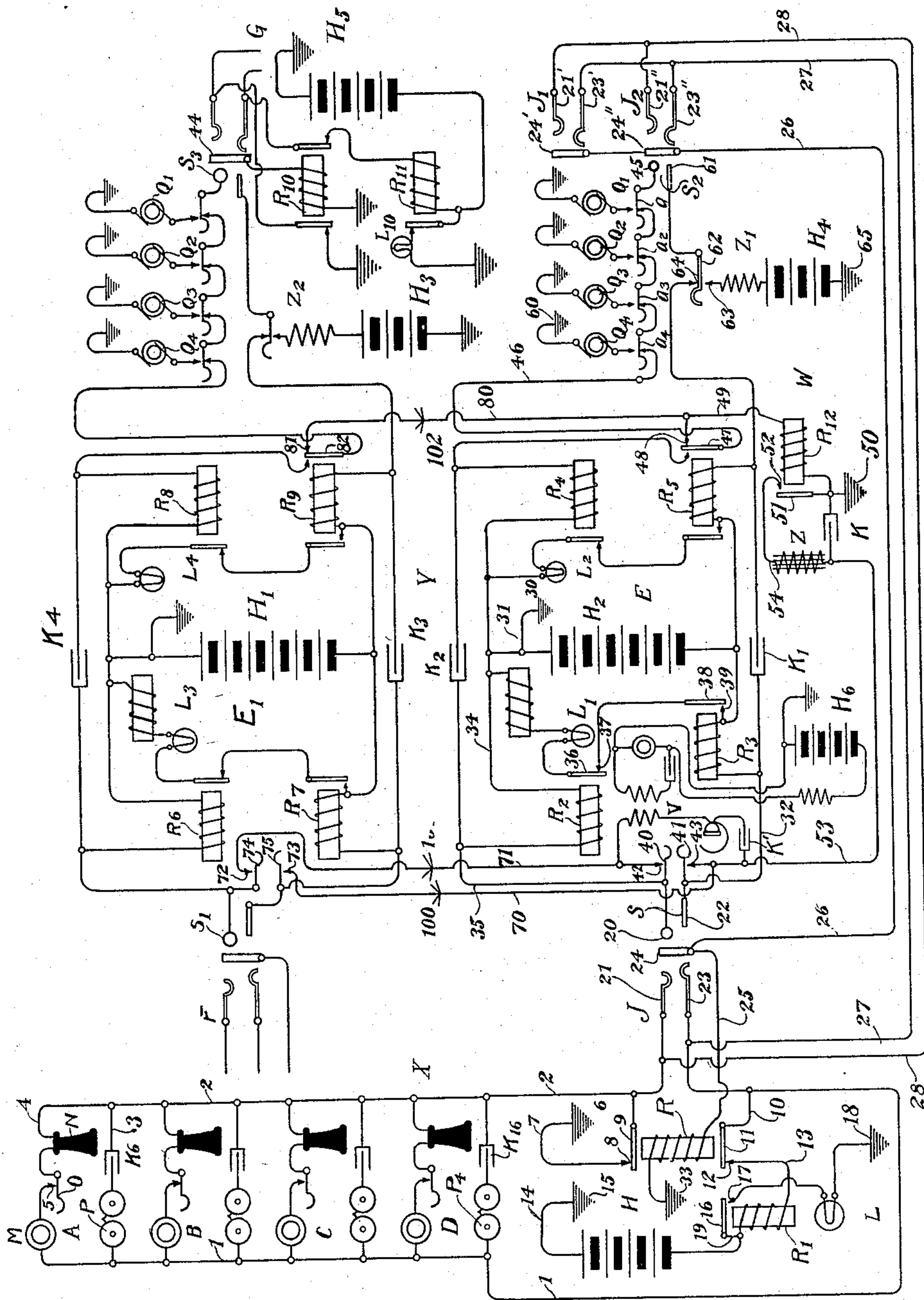


S. A. BEYLAND.
TELEPHONE SYSTEM.
APPLICATION FILED JAN. 3, 1911.

1,201,797.

Patented Oct. 17, 1916.



Witnesses
Edgar A. Spurr
A. D. T. Libby

Inventor
Sidney A. Beyland
By F. O. Richey
His Attorney

UNITED STATES PATENT OFFICE.

SIDNEY A. BEYLAND, OF ELYRIA, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO STROMBERG-CARLSON TELEPHONE MANUFACTURING CO., OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,201,797.

Specification of Letters Patent.

Patented Oct. 17, 1916.

Application filed January 3, 1911. Serial No. 600,433.

To all whom it may concern:

Be it known that I, SIDNEY A. BEYLAND, a citizen of the United States, and a resident of Elyria, Lorain county, Ohio, have
5 invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of my invention, such as will enable others skilled in
10 the art to which it appertains to make and use the same.

My invention relates to telephone systems and more particularly to systems which employ what is known as reverting busy testing circuits. Every telephone line leads
15 from the station or stations upon that line to a central station where the line terminates in a plurality of jacks or connecting and testing terminals. Each line will have one
20 of these terminals before each of a plurality of operators' positions. Each operator's position is furnished with a plurality of current conductors commonly in the shape of cord circuits which are employed to connect
25 the terminals of two lines together. Before making this connection, the operator will test the terminal of the called line to ascertain whether or not that line is in use. If the calling party happens to be upon a
30 party line and calls for a subscriber who is also on that line and the operator tests the multiple jack of the called line, unless some provision is made to meet the contingency, a busy test will be given as the system is incapable of distinguishing between the presence
35 of a calling and called subscriber upon the line. The operator will then indicate to the calling subscriber that the line of the desired party is busy which will not be true. To prevent such errors, I provide means for giving a distinctive signal when the condition of affairs that I have described arises. In the systems heretofore provided for obviating this difficulty, special means for producing a special signal have been provided.
45 This loads the system down with additional apparatus, as in the case of most of the circuits with apparatus which is continuously operating and which is more or less
50 apt to produce special tones in the various telephone sets connected to the system. While I employ means for producing a special signal, that means consists largely in

apparatus ordinarily employed with circuits of this character, the special part being limited. I thus avoid much of the additional
55 apparatus ordinarily used with these circuits. My device is normally inactive and is common to both the testing circuit and to the reverting busy testing circuit, so that
60 I do not add any apparatus to the circuit, which is employed for testing, that produces noises when the reverting test is employed. The operator is thus prevented from receiving the reverting test when using the
65 direct test or at other times except when such a test is desired. I also employ one of the talking strands for the reverting test and use apparatus which is common to a
70 plurality of cord circuits for giving the testing and reverting test signals.

Other objects of my invention and the invention itself, will be best understood by reference to the following description when taken in connection with the accompanying
75 illustration showing one specific embodiment thereof, while the scope will be more particularly pointed out in the appended claims.

In the drawing I show a diagram of my
80 system.

At X upon the left hand side of the drawing I show a diagrammatic representation of a polystation line. The main conductors of this line are shown at 1 and 2. These
85 conductors lead from a plurality of sub stations A, B, C, D, to an answering jack J which is mounted upon the switchboard at one of the operator's positions. Sub station apparatus at each of these stations consist as shown at station A, of a bridge 3
90 containing a condenser K^c and a signal P which is here shown as a bell. A second bridge 4 contains the transmitter M, the receiver N and a receiver hook O which controls the bridge. At the central station I show a lamp L which is commonly known as a line lamp. This is controlled by relay
95 R¹, commonly known as the line relay, a second relay R, known as the cut off relay, 100 is associated with the terminal of this line and serves the function of cutting the line lamp and relay off when the line is being used for conversation. The terminal of this line is multiplied by jacks J¹ and J², which
105 are connected to the jack J as shown.

At E and E¹ I show two pair of current conductors for connecting the lines together. While I have shown only two conductors any desirable number may be employed. These are shown here as cord circuits. The cord circuit E terminates in an answering plug S and a calling plug S². These plugs coöperate with the jacks when inserted therein, connecting the conductors of the cord with the lines of the jack. The two ends of the cord are separated by condensers K¹ and K² as shown.

L¹ and L² are the supervisory lamps. R², R³, R⁴ and R⁵ are relays which control the circuits of these lamps.

Q¹, Q², Q³ and Q⁴ are sources of current for operating the signals at the substations.

At H, H² and H⁴ I show sources of current. The cord circuit E¹ terminates in the plugs S¹ and S³.

At F and G I show jacks of other lines which lead to the switchboard.

The supervisory lamps are shown at L³ and L⁴. Relays R⁶, R⁷, R⁸ and R⁹ control the circuit of these lamps. The ends of the conductors are separated by condensers K³ and K⁴. The generators Q¹, Q², Q³ and Q⁴, supply the signaling current. The source H¹, H³ and H⁵ supply current for talking and other purposes.

L¹⁰ is the line lamp of the line terminating at the jack G.

R¹¹ is the line relay and R¹⁰ the cut-off relay of said line.

An operator's set is shown at V. This set is common to a plurality of cord circuits as shown in the figure. The test relay R¹² is also common to a plurality of cord circuits.

While I have for convenience illustrated separate batteries H, H¹, H², H³, H⁴, H⁵, and H⁶, as a matter of fact, these batteries are all the same being the common battery of the system.

The apparatus employed, the objects of the invention and the invention itself, will be best understood from the following description of the operation: Supposing for example, the subscriber at A desired to talk with the subscriber at D. The subscriber at A removes the receiver N from the hook O. This hook being spring pressed upward, will arise and engage the contact 5 from which it is normally held apart. The following circuit will be closed thereby: from ground at 6—conductor 7—contact 8—armature 9—2—4—N—O—5—M—1—10—armature 11—contact 12—conductor 13—R¹—H—14 to ground at 15. The relay R¹ will be energized, pulling up its armature 16 which engages the contact 17, completing the following circuit: ground at 18—L—17—16—19—H—14—to ground at 15. The lamp L will be illuminated by current over this circuit and being placed before the operator will indicate to her that a connection is de-

sired. She will then insert the plug S into the answering jack of the line X. The tip of the plug 20 will engage the jack spring 21, connected with the conductor 2, the sleeve 22 of the plug will engage the spring 23 connected to the conductor 1 and the ring 24 which is connected by the conductor 25 to the cut-off relay R. The ring 24 is connected by conductor 26 to the rings 24' and 24'' of the multiple jacks J¹ and J² respectively. The sleeve spring 23 is connected by a conductor 27 to the sleeve spring 23' and 23'' of said multiple jacks. The tip spring 21 is connected by a conductor 28, to tip springs 21' and 21'' of said jacks. When the plug has thus been inserted into the jack J, the following circuit will be completed: from ground 30—31—H²—R³—32—22—24—25—R—to ground at 33. The relay R will be energized pulling up its armatures 9 and 11 and cutting off the line lamp and relay. Owing to the fact that the subscriber at A has completed a bridge of his line, the following circuit will also be completed when the plug is inserted into the jack: H²—34—R²—35—20—21—2—4—N—O—5—M—1—23—22—32—R³ back to H². Both the relays R² and R³ will be energized. R² will attract its armature 36 drawing it away from the contact 37 and opening the lamp circuit. The relay R³ will attract its armature 38 to engage the contact 39 and closing a switch in the lamp circuit. Since the circuit of this lamp L¹ is broken at 36—37, the same will not be energized. The operator then throws her listening key and the springs 40 and 41 engage the contacts 42 and 43 respectively, bridging the operator's set V upon the cord circuit and connecting the operator with the subscriber A. The operator then inquires the number desired and having ascertained that the subscriber D is wanted, proceeds to test the multiple jack of the line upon which the subscriber D is connected. Assuming for a moment that this subscriber was on such a line as terminates at G, which is independent of the line X, the ring 44 of this line will be at a potential higher than that of the tip 45 of the plug S². This will be apparent from the previous description in which it was shown that the battery H² was connected to the ring 24 when the plug was inserted in the jack. When the tip 45 is applied to the ring 44, which the operator does to test the line, current will flow from 44—45—the ringing springs—the conductor 46—the armature 47 of the relay R⁵—the forward contact 48 thereof—49—R¹²—to ground at 50, energizing the relay R¹² which pulls up its armature 51 and closing a switch 51—52. When the operator threw her listening key, the condenser K, which is connected across the terminals of this switch was charged over the following circuits: 50—K—53—43—

41—32—R³—H²—31 to ground at 30. When the switch 51—52 is closed, this condenser will discharge through the shunt 54, part of the discharge going through 53—43—41—
 5 22—26—45—46—47—48—R¹². These cause a disturbance of the equilibrium of the current in the circuits connected with the operator's head set so that an impulse of current will flow therethrough and causes a click in
 10 the ear of the operator. This indicates to her the busy condition of the line.

Should it happen as in the case we have taken that the subscriber D was upon the same line as the subscriber A, the operator
 15 would receive the same click and would report to A that D was busy, which is not true. In order to prevent this, I have provided a testing circuit which gives a special signal when the called and calling subscriber are
 20 upon the same line. The operator would in this case apply the tip 45 of the plug S² to one of the rings 24' or 24''. In that case the following circuit would be closed: 24''—26—24—22—the sleeve strand of the
 25 cord 32—R³—H²—31 to ground at 30, ground at 50—R¹²—49—48—47—46—45—back to 24''; the relay R¹² would be energized as before, pulling up the armature 51 and closing the switch 52 completing a shunt of the circuit just described in which the relay R¹² is
 30 shunted out and deenergized, current now going from ground at 30—31—H²—R³—32—41—43—53—Z—54—52—51—to ground at 50. When the relay R¹² is thus deenergized, the armature 51, which is spring
 35 pressed away from the contact 52 will open the switch 51—52 interrupting the shunt circuit just described and causing the reenergization of the relay R¹². Each time the circuit is made or interrupted, an impulse of
 40 current will pass over the conductors associated with the operator's head set and first in one direction and then in the other as the condenser is charged and discharged she will
 45 get a special tone in her head set. When the condenser K is charged an impulse of current will pass through the conductor 53 in one direction and when this condenser discharges, an impulse will pass through in the
 50 other direction. Thus, when one end of the connecting conductors is applied to the testing terminal of a line to which the other end of the current conductors is already connected, a special signal differing in the tone from
 55 the normal test signal will be given. This special tone is produced by the battery as modified by the coil Z and the condensers K and K¹ which have a commutator effect on such current. These members constitute a
 60 source of distinctive current which is heard in the operator's receiver when the reverting test circuit is closed. This special tone cannot effect the current in the operator's set unless the plug is applied to a line already
 65 connected to the cord, as the conductor 26

will be absent and the circuit of said relay, just described, will be opened. The shunt through 51 will fail to shunt this relay out of its normal test circuit. By this arrangement of circuits, I exclude the special tone
 70 from the operator's set except when making a reverting test. Having learned that the called and calling subscribers are upon the same line, the operator will advise the subscriber A, requesting that he hang up his re-
 75 ceiver while she signals the called subscriber. This is done by withdrawing the plug S and inserting the plug S² into the jack. She then operates the ringing key which corresponds to the signal at the station D and the
 80 said signal will be operated by current over the following circuit assuming that the generator Q⁴ will furnish current to operate the signal P⁴: ground at 60—Q⁴—spring
 85 a⁴—45—the tip spring—conductor 2—condenser K¹⁶—P⁴—conductor 1—the sleeve spring—sleeve 61—62—63—H⁴ to ground at 65. The battery H⁴ serves to hold up the cut-off relay, while the sleeve strand is interrupted at 62—64, which will be the state
 90 of affairs during the ringing. As soon as the subscriber D has answered both subscribers come back on the line and conversation takes place. The operation of the supervisory lamp L and L² is so well known
 95 that it will not be described here, their use being only collateral to my invention. When the subscribers have finished their conversation, they will hang up their receivers, the supervisory lamp will indicate that fact, and
 100 the operator in a well known way will withdraw the plug restoring the system to its normal condition.

The operator's set is connected by conductors 70 and 71 to contacts 72 and 73 which
 105 coöperate with the listening springs 74 and 75 of the cord circuit E¹. The relay R¹² is connected by a conductor 80 to a contact 81 which coöperates with the armature 82 of relay R⁹ of the cord E¹ making this device
 110 common to these two cords. The operator's set and the test relay R¹² and associated apparatus may be connected to many cord circuits by conductors taken off at 100, 101 and 102.
 115

The inductive resistance Z is so proportioned to the resistance of the cut off relay that said relay will not be shunted through
 120 32—41—43—53—Z—54—52—51—50 when the switch 41—43 is closed and the relay R¹² pulls up.

The condenser K may be omitted as the coil Z is sufficient to produce the desired signal. I prefer, however, to employ a condenser K as the signal will be louder.
 125

It will thus be seen that I employ a portion of the cord circuit in my reverting busy test circuit; that I use a single device for controlling both the busy test and reverting busy test signals; that said device is
 130

inoperative except when its operation is required to give signals and that it is common to a plurality of cord circuits.

While I have shown this particular form, it will be obvious to those skilled in the art that numerous and extensive departures from the details of this form may be made without departing from the spirit of the invention, such form being herein shown solely for the purpose of clearly illustrating one specific embodiment of said invention.

I claim:

1. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, one at least of said lines being a polystation line, a plurality of testing terminals for each line at said central station, means at said central station for connecting said lines together in conversational relation, a testing circuit for indicating the idle or busy condition of a called line, a reverting busy testing circuit for indicating when the calling and called subscribers are on the same line, and means common to said test circuits for producing a signal when connected in said test circuit and for producing a distinctive signal when connected in said reverting busy test circuit.

2. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, a reverting busy testing circuit and means to produce a current of distinctive characteristics when said circuit is closed, the operation of said means being controlled by said circuit.

3. In a telephone system, the combination of a central station, a plurality of telephone lines, one at least of which is a polystation line, a plurality of testing terminals at the central station for each line, means to connect two of said lines together, a relay and means to operate said relay when said first named means is applied to the terminal of a busy line whereby a signal is produced to indicate the busy condition of the tested line, said relay acting to produce a different signal when said first named means is applied to a testing terminal of a line to which said means is already connected.

4. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, one at least of said lines being a polystation line, a plurality of testing terminals for each line at said central station, a cord circuit for connecting two of said lines together in conversational relation, and a device associated with said cord circuit for producing a signal when the tip of said cord is applied to the terminal of a busy line and for producing a distinctive signal when the tip of the cord is applied to the terminal of a line to which the cord is already attached.

5. In a telephone system, the combination

of a central station, a plurality of telephone lines terminating thereat, one at least of which is a polystation line, a plurality of terminals for each line at the central station, a cord circuit for connecting said lines together, a busy test circuit associated with said cord, a reverting busy test circuit associated with said cord and means common to said test circuits for producing a signal when the tested line is busy and for producing a distinctive signal when said reverting busy test circuit is closed.

6. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, a plurality of terminals at the central station for each line, means for connecting said lines together, a relay associated with said cord circuit, a circuit over which said relay is energized when said means is applied to the terminal of a line to which said means is already connected, and a shunt adapted to shunt said relay when said relay is energized.

7. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, one at least of said lines being a polystation line, a plurality of terminals for each line at the central station, a pair of conductors for connecting two of said lines together in conversational relation, a busy testing circuit, a reverting busy testing circuit including a portion of one of said pair of conductors and a device common to said testing circuits for producing a signal when the busy testing circuit is closed and for producing a distinctive signal when said reverting busy testing circuit is closed.

8. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, one at least of said lines being a polystation line, a plurality of terminals at the central station for each line, a pair of conductors for connecting said lines together for conversation, a reverting busy testing circuit including a portion of one of said conductors, a relay adapted to be connected in said circuit and a shunt of said relay adapted to be closed to shunt said relay when said relay is energized, whereby a signal is produced to indicate that the reverting busy testing circuit is closed.

9. In a telephone system, the combination of a central station, a plurality of telephone lines terminating at said central station, one at least of said lines being a polystation line, a plurality of terminals at the central station for each line, a plurality of cord circuits at the central station for connecting said lines together, and a common device for producing a signal when the tip of any of said cords is applied to the terminal of a busy line and for producing a distinctive signal when the tip of any of said cords is

applied to the terminal of a line to which line such cord is connected.

10. In a telephone system, the combination of a central station, a plurality of telephone lines terminating thereat, one at least of said lines being a polystation line, a plurality of testing terminals for each line at the central station, a plurality of cord circuits for connecting said lines together for conversational purposes and means common to a plurality of cord circuits for giving a signal when a busy line is tested, said means giving a distinctive signal when the test is made by applying a cord circuit to a line to which line said cord is already connected.

11. In a telephone system, the combination of a central station, a plurality of tele-

phone lines terminating at said central station, one of which at least is a polystation line, a plurality of terminals at the central station for each line, electro-responsive devices at the central stations, relays controlling the same, a busy test circuit, a reverting busy testing circuit and another relay adapted to produce a signal when said busy test circuit is closed and a distinctive signal when said reverting busy testing circuit is closed.

In testimony whereof, I affix my signature in the presence of two witnesses.

SIDNEY A. BEYLAND.

Witnesses:

A. D. T. LIBBY,

F. O. RICHEY.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."