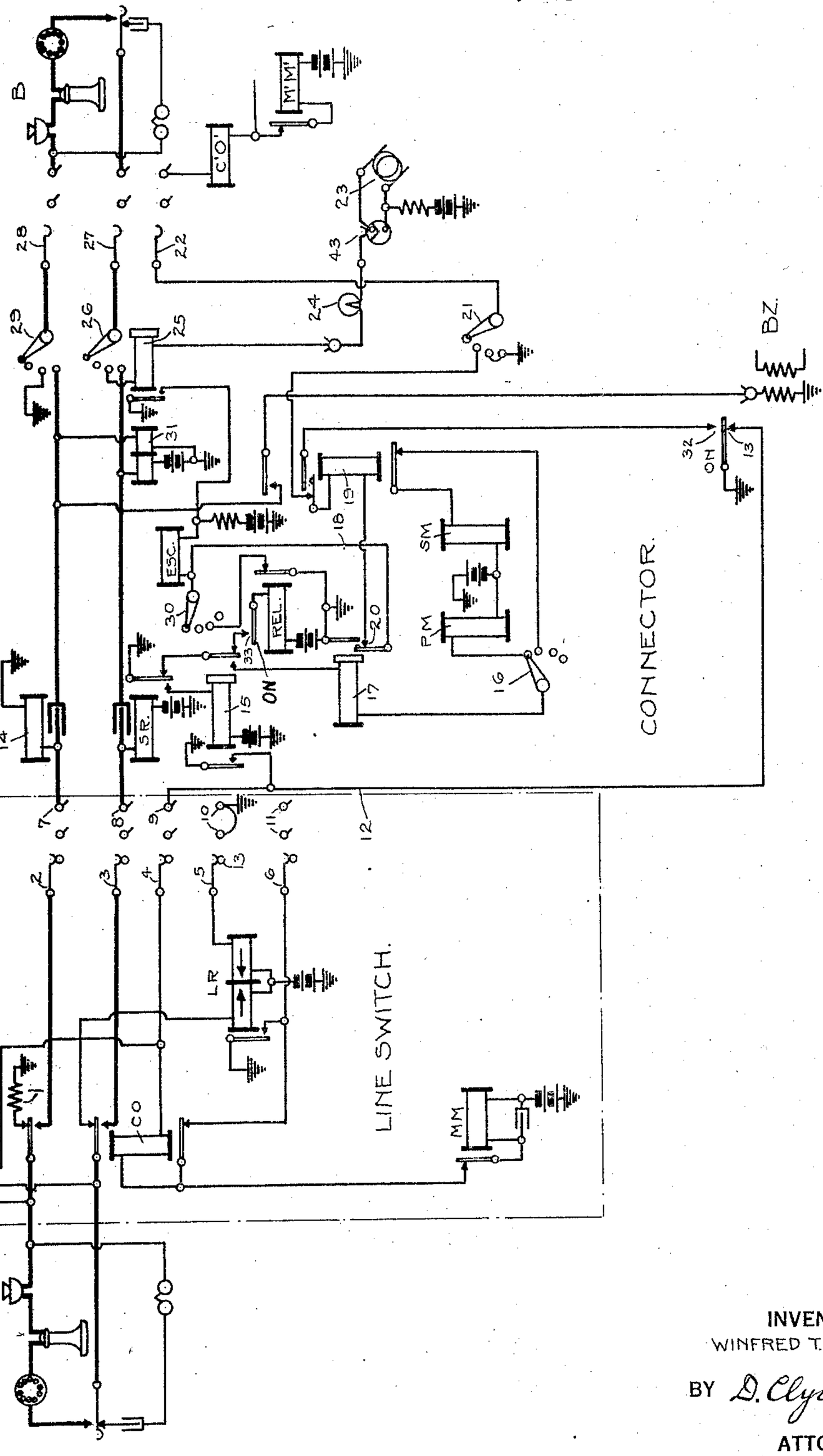
Aug. 25, 1925. 1,551,169

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed May 8, 1919



INVENTOR
WINFRED T. POWELL.
BY D. Clyde Jones
ATTORNEY

Patented Aug. 25, 1925. 1,551,169

UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

AUTOMATIC TELEPHONE SYSTEM.

Application filed May 8, 1919. Serial No. 295,742.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing in Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems, and more particularly to that class of telephone systems which employs automatic switches in completing a connection between a calling and a called party.

The present invention has for its purpose the design of improved and simplified circuits for operating a distributor switch and for the co-operation of this switch with other automatic switches. Other features not specifically enumerated will appear from the detailed description and from the appended claims.

The drawings diagrammatically represent a portion of the telephone system; only so much of this system is shown as is necessary for a complete understanding of the present invention. At the left of the drawing there is represented a calling substation, while within the dotted rectangle there is represented the operating circuits of a line switch or distributor switch. At the right of the dotted rectangle near the center of the drawing the operating circuits of a connector switch are shown, while at the extreme right of the drawing a called sub-station is represented.

The line or distributor switch which will be referred to in the detailed description, comprises a flat rotary switch in which there are five series of contacts arranged to form an arcuate bank. Five brushes are provided; each one of these brushes co-operating with one of the five series of contacts. These brushes are rotated only in one direction; that is, the brushes of the switch are advanced to select an idle trunk leading to a selector or connector switch and when the connection is disestablished the brushes continue to rotate in the same direction until the normal position of the switch is reached.

The connector switch which will be referred to in the description, may be of the type substantially the same as that shown in the patent to Keith et al. 815,176, issued March 13, 1906.

It is believed that the operation of this system will best be understood by describing the method of completing a call from the calling sub-station indicated at A, to the called substation indicated at B.

When the calling subscriber at A removes his receiver from the switchhook, the differential line relay LR, is energized over a circuit completed from grounded battery through its left hand winding, through the upper back contact and armature of the cut-off relay CO, through the calling subscriber's line, upper armature and back contact of the cut-off relay CO, through the resistance 1 to ground.

It should be noted that the line relay is of the differential type, that is, it is designed to attract its armature when either of its windings are energized but immediately retracts its armatures when both of its windings are simultaneously energized.

Since the opposing right hand winding of the line relay LR is not energized at this time, while the left hand winding is operated, this relay attracts its armature to complete a circuit from ground through the lower back contact and armature of the cut-off relay CO, through the back contact, armature and winding of the stepping or motor magnet MM, to grounded battery. Under the control of this circuit, the motor magnet MM advances the five brushes of the switch from their normal position.

It will be understood that as soon as the brushes have been moved from normal position, that is, when brush 5 encounters one of the contacts 10 which are connected to ground after the manner of an off normal switch, the right hand winding of the differentially wound line relay is energized, and since the right and left hand windings of this relay oppose each other at this time, its armature is retracted. The operating circuit for the motor magnet MM, is then extended from the lower armature and back contact of the cut-off relay CO, through the test brush 6, through the test terminals 11 of busy trunks to ground at the armatures and front contacts of line relays associated with line switches that have seized these trunks. When, however, an idle trunk is found, the cut-off relay CO, is energized in

series with the motor magnet MM, through brush 4, through terminal 9, normally closed contact 13, to ground. The motor magnet MM, however, will not operate in series with the cut-off relay. As soon as the cut-off relay CO. has operated to interrupt the circuit including the left hand winding of the line relay LR., the circuit including the right hand winding of this last named relay is effective to cause the attraction of its armature to apply a guardlng potential to the selected trunk.

As soon as the idle trunk is seized, the stepping relay SR of the selector or connector, as the case may be, is energized over a circuit traceable from grounded battery, winding of this relay, terminal 8, brush 3, inner front contact and armature of the cut-off relay, through the calling subscriber's sub-station circuit, upper armature and front contact of the cut-off relay, brush 2, terminal 7 of the selected trunk, winding of impedance coil 14, to ground. The stepping relay SR attracts its armature and at its front contact completes an energizing circuit for the slow releasing relay 15. This relay at its left hand contact and armature completes a holding circuit for the cut-off relay CO.

The subscriber at A now operates his dial switch in accordance with the first digit of the desired number and since it has been deemed necessary to show only a connector switch, this first digit will be of the tens order. In response to the interruptions in circuit of the stepping relay corresponding to the tens digit of the wanted number, the armature of the stepping relay SR will be caused to vibrate and at its back contact, completes a circuit for the primary stepping magnet PM from grounded battery, through the winding of the magnet, side switch wiper 16 in its first position, winding of the second slow releasing relay 17, right hand front contact and armature of relay 15, back contact and armature of stepping relay SR to ground.

In response to each interruption of the line circuit, the primary magnet attracts its armature and advances its wipers one step in the primary direction. When the energizing circuit of the primary magnet PM was first completed, the relay 17 was energized and since this relay is slow to release it does not retract its armature during momentary interruptions of its energizing circuit. As soon as the relay 17 is energized, a circuit for the escape magnet ESC is closed and maintained, from grounded battery, resistance, winding of the escape magnet, conductor 18, make-before-break contact spring and armature of the relay 17 to ground.

At the close of the tens series of impulses, the energizing circuit of the stepping relay SR will be maintained energized for a relatively long interval, so that the series circuit of the primary stepping magnet PM and the slow releasing magnet 17 is held open at the back contact and armature of the stepping relay SR. The slow releasing relay 17 under these conditions, deenergizes and thereby interrupts the energizing circuit of the escape magnet. This escape magnet, as is well known, operates on deenergization to move the side switch wipers into their second position. The circuits of the connector are now in condition to receive the units series of impulses. In response to this series of impulses, the stepping relay SR again vibrates its armature, but in this instance controls the secondary stepping magnet SM over a circuit completed from grounded battery, winding of the magnet SM, lower armature and back contact of the test relay 19, side switch wiper 16 in its second position, winding of the slow releasing relay 17, right hand front contact and armature of relay 15, back contact and armature of relay SR to ground.

As soon as the relay 17 attracted its armature in response to the first of the units series of impulses, the escape magnet ESC is again energized over a circuit completed from grounded battery, resistance, winding of the escape magnet ESC, conductor 18, make-before-break contact spring and armature of relay 17 to ground.

When the slow releasing relay 17 deenergizes at the close of the units series of impulses, the energizing circuit of the escape magnet ESC is interrupted, if the desired line is idle, and the side switch wipers are then moved into their third position.

In this position of the side switch wipers ringing current is transmitted to the called sub-station over a circuit traceable from grounded battery, through the resistance, ringing machine 23, ringing interrupter 43, the lamp 24, winding of the slow releasing relay 25, side switch wiper 26, brush 27, through the called subscriber's circuit including the call bell, brush 28, side switch wiper 29 in its third position, to ground. The slow releasing relay 25, which is commonly known as the ringing trip relay, is marginal and does not operate until the receiver at the called sub-station is removed from its switchhook, whereupon it receives sufficient current to operate.

As soon as the side switch moved into its third position, the escape magnet ESC was energized over a circuit extended from grounded battery, through the resistance, winding of this magnet, side switch wiper 30 in its third position, back contact and armature of release magnet REL, to ground. The escape magnet is held energized in this circuit until the ringing trip relay 25 is energized on the called party's response. At

that time the escape magnet is short-circuited at the front contact and armature of the relay 25, causing the escape magnet to deenergize and move its side switch wipers into their fourth, or talking position.

The sub-stations A and B are now in telephonic connection, the talking battery for the calling sub-station being supplied through the winding of stepping relay SR and impedance coil 14, and the talking current for the called subscriber is supplied through the windings of the impedance coil 31.

It was assumed in the foregoing description that the called sub-station was unengaged. If at the time when the connector switch had moved its brushes 22, 27 and 28 into engagement with the terminals of the called line this line was busy, a busy tone would have been applied to the calling line and the connection would have failed of completion. It will be remembered that during the units series of impulses, the escape magnet ESC was energized over a circuit closed from grounded battery, through the resistance, winding of this magnet, conductor 18, spring contact of the relay 17, to ground. At the close of this series of impulses when the relay 17 retracts its armature, a substitute circuit for the escape magnet is completed which now extends from conductor 18, spring and contact 20, winding of test relay 19, spring and contact of this relay, side switch wiper 21 in its second position, test brush 22, through the terminals of the busy line to ground at side switch wipers 21 in their third or fourth positions at busy connectors. The test relay 19 is energized in this circuit and attracts its armatures, and at its upper armature closes a locking circuit for itself to ground at contact 32, and off normal spring. At the uppermost armature of the test relay 19, a circuit is completed for applying a busy tone to the calling line from the busy machine indicated at BZ.

At the close of the conversation when the callling subscriber replaces his receiver on its switchhook, the stepping relay SR which has been maintained energized during the conversation, retracts its armature to close an energizing circuit for the release magnet REL, from grounded battery, winding of this magnet, spring and off normal contact 33, right hand back contacts and armatures of relays 15 and SR, to ground. The release magnet is energized and operates in the well known manner to restore the connector switch to its normal position. It will be seen that as soon as the relay 15 deenergizes, that the holding circuit of the cut-off relay CO is broken at the left hand front contact and armature of the relay 15. As soon as the cut-off relay deenergizes, the motor magnet MM is operated over a circuit extending from grounded battery, winding, armature and back contact of the motor magnet MM, lower armature and back contact of the cut-off relay, front contact and armature of line relay LR, to grounded battery. The line switch continues to advance its brushes in the same direction in which it moved to select an idle trunk until the brush 5 engages the normal contact 13, whereupon the line relay LR retracts its armature to interrupt the operating circuit of the motor magnet. The apparatus is now in condition to receive another call.

In the present disclosure the circuits of the invention have been shown associated with a line switch which operates to select idle trunks leading to connector switches, but it will be understood that these circuits may be employed with any distributor switch, and if utilized as a line switch, may be employed to select idle trunks leading to selector switches instead of to connector switches as herein disclosed,. It will be readily understood that the distributor circuits here disclosed may be employed to apportion calls to operators on a call distributing system.

What I claim is:

1. In a telephone system, an incoming line, a plurality of outgoing lines, a differential line relay individual to each incoming line and controlled in part thereover, a cut-off relay individual to each incoming line, a switch for connecting said incoming line to any outgoing line, an operating magnet for said switch, and a circuit for said magnet jointly controlled by said line and cut-off relays.

2. In a telephone system, an incoming line, outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, said switch having a normal position, controlling means for said switch including a line relay initially energized over said incoming line, means for deenergizing said line relay as soon as the switch is moved from its normal position, a cut-off relay operative when an outgoing line is seized, a magnet for advancing said switch, and a circuit for said magnet jointly controlled by said line and cut-off relays.

3. In an automatic telephone system, an incoming circuit, a plurality of outgoing circuits, a switch for interconnecting said incoming circuit with any of said outgoing circuits, a cut-off relay individual to said incoming circuit, a line relay having contacts cooperating in the control of said switch, a circuit for said line relay normally connecting it to said incoming circuit through contacts of said cut-off relay, means for energizing said line relay and said cut-off relay when said switch seizes an outgoing circuit, and a busy potential for said selected outgoing circuit applied at contacts of said line relay.

4. In a telephone system, an incoming line, a plurality of outgoing lines, a normaling non-numerical switch for interconnecting said incoming line with any of said outgoing lines, a line relay cooperating in the control of said switch, means to energize said line relay, means responsive to the energization of said line relay to initiate the operation of said switch in selecting an outgoing line and to continue the advance of said switch, and means to maintain said line relay energized until said switch is restored to normal.

5. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, a line relay cooperating in the control of said switch, and means controlling said line relay for energizing the same to initiate the operation of said switch, for deenergizing the same during the outgoing line selection operation of said switch and for energizing the same again during the holding of said outgoing line and during the release movement of said switch.

6. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, a line relay and a cut-off relay cooperating in the control of said switch, means for energizing said line relay to initiate the line selecting operation of said switch, for deenergizing said line relay during the line selecting operation of the switch, means for operating said cut-off relay when an outgoing line is seized, and means including a portion of said first mentioned means and controlled in part by said cut-off relay for energizing said line relay to effect the release of said switch.

7. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, a line relay and a cut-off relay individual to each line, a motor magnet for advancing said switch, said line relay having windings differentially arranged, a circuit for one winding of said line relay completed over said incoming line, a circuit for the other winding of said line relay completed as soon as said switch is advanced, operating circuits for said motor magnet controlled in part by said line and cut-off relays, and a circuit for said cut-off relay in shunt of the operating circuits of said motor magnet completed while busy trunks are being tested.

8. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, a motor magnet for advancing said switch, a line relay cooperating in the control of said motor magnet, said line relay having two windings, a circuit completed through one of the windings of said line relay to cause said motor magnet to advance said switch, means to cause said motor magnet to continue the advance of said switch, and a circuit completed through the other winding of said line relay until said switch is in its normal position for causing said motor magnet to restore said switch to normal, position.

9. In a telephone system, a plurality of points, means for making points unselectable, a non-numerical point finder, a relay having one winding for initiating the movement of said point finder, means for continuing the movement of said point finder, a second winding on said relay for causing an additional movement of said point finder, means for stopping the point finder in engagement with a selectable point, means including a circuit through one winding of said relay to energize the same and means to complete a circuit through another winding of said relay to deenergize the same.

10. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, an off-normal contact on said switch, a differential line relay individual to each incoming line and cooperating in the control of said switch, said relay having two windings, one winding of said relay being energized over the incoming line to start said switch, a circuit for the other winding of said relay completed through said off-normal contacts, means for advancing the said switch, and a circuit for said means controlled in part at said line relay.

11. In a telephone system, an incoming telephone line, a plurality of outgoing trunks, means for characterizing said trunks by a busy or idle condition, a switch for interconnecting said incoming telephone line with any idle trunk, a differential line relay arranged to be energized over two sides of the talking conductors of said telephone line in series, means for deenergizing said line relay while busy trunks are being encountered and for energizing said line relay when an idle trunk is seized, means for advancing said switch, and an operating circuit for said means completed by said line relay.

In witness whereof, I hereunto subscribe my name this 7th day of May A. D. 1919.

WINFRED T. POWELL.