

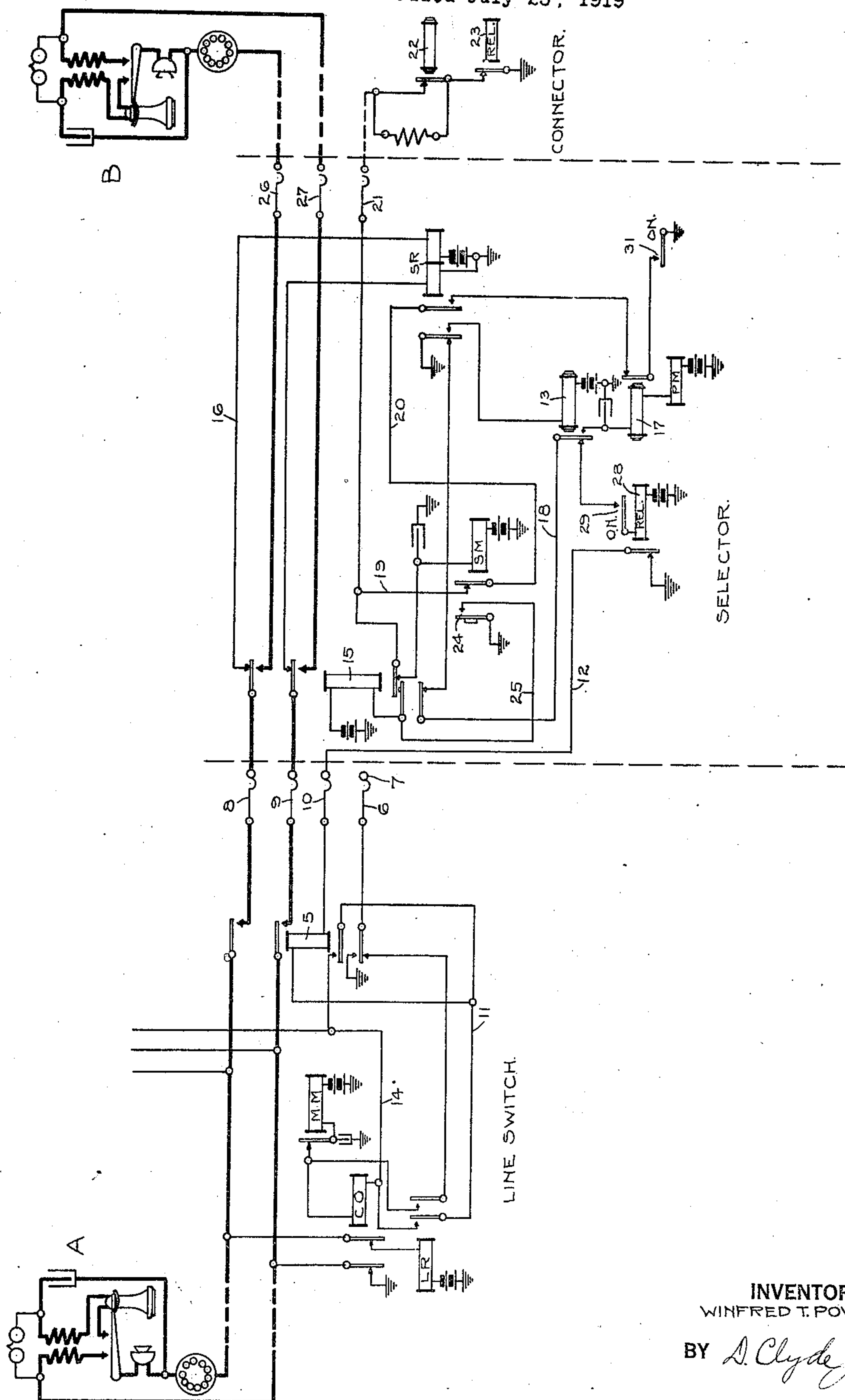
July 29, 1924.

W. T. POWELL

1,502,916

AUTOMATIC TELEPHONE SYSTEM

Filed July 23, 1919



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Patented July 29, 1924.

1,502,916

UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

Application filed July 23, 1919. Serial No. 312,824.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at 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.

10 This invention relates to telephone systems, and more particularly to telephone systems employing machine switching in establishing conversational circuits between calling and called subscribers.

15 The present invention has for its purpose the simplification of circuits of the numerical and non-numerical switches employed in automatic telephone systems. It is proposed in these circuits to reduce the number of controlling electromagnets or relays without diminishing the speed of operation of the switches and without lessening the reliability of the various testing operations.

20 Other features not specifically enumerated will appear from the following detailed description and the appended claims.

25 The drawing diagrammatically represents a portion of a telephone system in which the circuits of the present invention have been incorporated. The portion of the drawing at the left of the dotted lines represents the substation circuits of a calling line, as well as the operating circuits of a line switch individual to this line. The portion of the drawing included between the two dotted lines represents the operating circuits of a selector or a connector switch, while at the right of the dotted lines there is shown the release magnet and the first slow-releasing relay of a second selector or a connector switch circuit through which the called substation may be reached.

35 The line switch may be of any form of rotary line switch that has no normal position, while the selector switch may be of the type similar to that shown in the patent to Keith et al., No. 815,321, issued March 13th, 1906, when modified to operate without a side switch in a so-called two-wire system.

40 The connector or second selector circuits of which only the first slow-releasing relay and release magnet are shown, may be similar to any selector or connector circuits employing fast and slow relays either with or with-

out a so-called side switch when modified 55 as indicated at the extreme right of the drawing.

It is believed that the invention will best be understood by describing the operation of establishing a connection between a calling 60 substation A and a called substation B. When the calling subscriber at A removes his receiver from its switchhook, the line relay LR is energized over a circuit extending from grounded battery, winding of the 65 line relay, inner back contact and armature of the cut-off relay CO, upper side of the calling line and its substation circuits, lower side of the calling line, outer armature and back contact of the cut-off relay to ground. 70 The line relay LR is energized in this circuit and attracts its armatures. With the line relay LR energized, when the brushes of the line switch are in engagement with the terminals of a busy trunk, an operating circuit 75 for the motor magnet MM is closed from grounded battery, winding, armature and back contact of the motor magnet, outer front contact and armature of the line relay, lowermost armature and back contact of 80 relay 5, test brush 6, test terminal 7 of the busy trunk, to ground over a line switch test brush similar to 6, lowermost armature and front contact of a relay similar to 5, to ground at the line switch that has previously 85 seized the trunk being tested.

Under the control of a circuit similar to that just described, the motor magnet continues to advance its brushes 8, 9, 10 and 6 until its test brush 6 encounters the test 90 terminal characterized by the absence of ground, a condition which indicates that the trunk is idle. As soon as the idle trunk is reached, the cut-off relay CO and the relay 5 are energized in series in a circuit traceable from grounded battery, winding of the 95 motor magnet MM, armature and back contact of this magnet, winding of the cut-off relay CO, inner front contact and armature of the line relay LR, conductor 11, winding of the relay 5, brush 10 of the line switch and holding terminal of the idle trunk, conductor 12, armature and back contact of release magnet 28 to ground. The motor 100 magnet MM is not energized in this circuit, but the relays 5 and CO are energized and attract their armatures. The cut-off relay CO disconnects the line relay from the call- 105

ing line, but before this takes place a substitute circuit is completed for the cut-off relay CO from grounded battery, winding and back contact of the motor magnet MM, winding of the cut-off relay, conductor 14, inner front contact and lower armature of relay 5, conductor 11, winding of the relay 5, brush 10 of the line switch, the holding terminal of the trunk seized, to ground over conductor 12 at magnet 28.

As soon as the relay 5 attracts its armatures, the stepping relay SR of the selector switch is energized over a circuit completed from grounded battery, right hand winding of this relay, conductor 16, uppermost back contact and armature of relay 15, brush 8 of the line switch, uppermost front contact and armature of the relay 5, through the substation circuits of the calling line A, inner, upper armature and front contact of the relay 5, brush 9 of the line switch, middle armature and back contact of the relay 15, left hand winding of the stepping relay SR, to ground. The stepping relay SR attracts its armatures and maintains them actuated until the calling subscriber operates his substation sender. At the outer armature and front contact of the stepping relay SR, an operating circuit is closed for the slow-releasing relay 13, which attracts its armature. At the armature and back contact of relay 13, the operating circuit of the release magnet 28 is opened, thus preventing the release of the switch, and at its armature and front contact a break point in the operating circuit of the primary motor magnet PM is closed.

As soon as the calling subscriber at A operates his substation sender, the stepping relay SR vibrates its armatures in the well known manner to complete an operating circuit for the primary motor magnet PM, from grounded battery, winding of this magnet, winding of the slow-releasing relay 17, front contact and armature of relay 13, conductor 18, lowermost armature and back contact of relay 15, outer back contact and armature of stepping relay SR, to ground. The primary motor magnet is thus operated in response to each impulse transmitted to the stepping relay SR, and advances the brushes of the selector switch, step-by-step in its group selecting movement. The slow-releasing relay 17 as is well known, is so adjusted that it will not retract its armature during momentary interruptions of its operating circuit, but will only retract its armature at the close of a series of impulses.

When the selector switch has completed its directive movements under the control of the substation sender and has selected a group of trunks over one of which the calling line may be extended, the selector switch then begins its automatic operation

to hunt for an idle trunk in the selected group. The primary magnet is no longer effective since its operating circuit is held open at the attracted armature of the stepping relay SR, but the secondary motor magnet SM, however, is operated over a circuit closed from grounded battery, winding of this magnet, continuity contact and spring of the relay 15, conductor 19, inner back contact and armature of secondary motor magnet SM, conductor 20, inner armature and front contact of stepping relay SR, back contact and armature of relay 17, off normal contact and spring 31, to ground. Under the control of this circuit, the secondary motor magnet advances the brushes of the selector into engagement with the first trunk of the selected group. If this trunk is idle, it will be seized in a manner to be described, but if this trunk is busy, the secondary magnet SM will continue to interrupt its local current extending to ground at off normal contact 31, to advance the brushes 21, 26 and 27 of the selector over the terminals of busy trunks. The idle condition of the trunk is indicated by direct ground on its test terminal, while a busy condition of the line is indicated by ground through a relatively high resistance. Let it be assumed that the second trunk tested, which is the trunk shown in the drawing, is idle so that as soon as the test brush of the selector engages the test terminal of this trunk, the secondary magnet is maintained energized for a relatively long interval over a circuit now traced from grounded battery, winding of the secondary motor magnet SM, continuity contact and spring of relay 15, test brush 21, test terminal of the idle trunk, back contact and armature of the first slow-releasing relay 22 of the selector, or connector as the case may be, back contact and armature of the release magnet 23, to ground. Since the secondary motor magnet is energized for a comparatively long time, it attracts its sluggish armature 24 which has previously remained inactive, and this operation closes a circuit for operating the relay 15. This circuit extends from grounded battery, winding of this relay, conductor 25, front contact and armature 24 of the secondary motor magnet SM, to ground. The relay 15 attracts its armatures extending the calling line through the brushes 26 and 27 of the selector to the idle trunk, and disconnects the stepping relay SR. At the lowermost armature and back contact of relay 15, the operating circuit of the primary motor magnet PM is opened, and at the contact and continuity spring of this relay the energizing circuit of the secondary motor magnet SM is interrupted. The relay 15 also closes a locking circuit for itself at this time from grounded battery,

its winding, lower armature and continuity spring, test brush 21 of the selector to ground at the armature and back contact of the release magnet 23, through the high resistance or through the contact and armature of the slow-releasing relay 22. The connection, may then be extended to an idle trunk leading to a connector through the operation of a second selector, the operating circuits of which are similar to the circuits of the selector just described. For purposes of this description, however, it has been assumed that the first selector will select a trunk leading to a connector which will seize and signal the wanted line in any well known manner.

A connector switch circuit is shown in the patent to Powell, No. 1,165,709, patented Dec. 28th, 1915, which will operate with the present selector switch circuits when modified as indicated at the extreme right of the present drawing. It will be readily understood from the last mentioned patent that the talking battery for the calling and called parties as well as the release of the connection is controlled at the connector switch.

At the close of the conversation, the release magnet 23 of the connector will be energized, due to the fact that the calling party has terminated the call, to open the holding circuit of the relay 15, causing this relay to retract its armatures. A circuit will thereupon be completed for the release magnet 28 of the selector from grounded battery, winding of the magnet 28, off normal contact and spring 29, inner back contact and armature of relay 13, conductor 18, lower-most armature and back contact of relay 15, outer back contact and armature of relay SR to ground. At the armature and contact of release magnet 28, the holding circuit of the relay 5 and cut-off relay CO are opened to reconnect the line relay LR to the calling line, and to disconnect the brushes 8 and 9 of the line switch from this line. The apparatus and circuits are now in condition to handle another call.

It will be noted that an improved selector switch has been provided in which no side switches are employed and wherein a minimum number of relays are necessary to insure rapid hunting for idle trunks, and reliable testing of these trunks for a busy or idle condition. The line switch circuit likewise employs a minimum number of relays and is swift and reliable in operation.

What I claim is:

1. In a telephone system, an automatic switch, primary and secondary magnets for operating said switch, a primary circuit for said primary magnet, an initial energizing circuit for said secondary magnet local to said switch, and a substitute circuit including the winding of said secondary magnet

and completed at a point remote from said switch, and releasing means therefor.

2. In a telephone system, an incoming line, a plurality of outgoing lines, a switch having primary and secondary movements to interconnect said incoming line with any of said outgoing lines, means for indicating the busy or idle condition of each of said outgoing lines, means for advancing said switch in its primary movement, and a secondary magnet for advancing said switch in its secondary movement, said secondary magnet serving to test for idle lines and to maintain itself actuated when an idle line is found.

3. 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 impulse relay normally connected to said incoming line and responsive to impulses from a distant point, brushes for said switch normally disconnected from said incoming line, controlling means operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, primary operating means for said switch controlled at said impulse relay, a secondary magnet therefor, a circuit for said secondary magnet having multiple branches, one of said branches being completed at said switch, and the other branch of said circuit being extended by said controlling means to a remote point.

4. 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 impulse relay normally connected to said incoming line and responsive to impulses from a distant point, brushes for said switch normally disconnected from said incoming line, controlling means operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, primary operating means for said switch controlled at said impulse relay, a secondary magnet therefor, a circuit for said secondary magnet having multiple branches, one of said branches being completed at said switch, and the other branch of said circuit being completed at said controlling means and at one of the brushes of said switch.

5. In a telephone system, an automatic switch, primary and secondary operating magnets for said switch, a circuit for said primary magnet, and a circuit for said secondary magnet having multiple branches, one branch being completed to operate said switch, and the other branch being completed to stop said switch.

6. In a telephone system, an incoming line, a plurality of outgoing lines, an automatic switch for interconnecting said in-

coming line with any of said outgoing lines, a mechanical switch associated therewith, an impulse relay normally connected to said incoming line and responsive to impulses from a distant point, brushes for said switch normally disconnected from said incoming line, controlling means operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, primary operating means for said switch controlled at said impulse relay, a secondary magnet therefor, and a circuit for said secondary magnet jointly governed by said controlling means, by said impulse relay and by said mechanical 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, an impulse relay normally connected to said incoming line and responsive to impulses from a distant point, brushes for said switch normally disconnected from said incoming line, controlling means operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, primary operating means for said switch controlled at said impulse relay, secondary operating means for said switch, and a circuit for said controlling means completed by said secondary operating means.

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, an impulse relay normally connected to said incoming line and responsive to impulses from a distant point, brushes for said switch normally disconnected from said incoming line, controlling means operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, primary operating means for said switch controlled at said impulse relay, a secondary magnet therefor, and circuits for said secondary magnet and controlling means having multiple branches, one branch to actuate and the other branch to hold actuated said secondary magnet and said controlling means.

9. In a telephone system, an automatic switch, primary and secondary operating magnets for said switch, circuits for said magnets, and controlling means for said switch, said secondary magnet being provided with armatures operating in different time intervals to advance said switch and to actuate said controlling means.

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 impulse relay normally connected to said incoming line and responsive to impulses from a distant point, brushes for said switch, normally disconnected from said incoming line, a controlling device operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, primary operating means for said switch controlled at said impulse relay, a secondary operating device for said switch, and initial operating circuits for said devices, the operating circuit for each device being completed at the other device.

11. In a telephone system, an incoming circuit, a plurality of outgoing circuits, an automatic switch for interconnecting said incoming circuit with any of said outgoing circuits, off-normal contacts on said switch, an impulse relay responsive to impulses transmitted over said incoming circuit, said impulse relay having front contact, a primary motor magnet for said switch arranged to be directive controlled by said impulse relay, a secondary motor magnet for said switch, and a circuit extending through the winding of the secondary motor magnet and completed at front contacts of said impulse relay and said off-normal contacts.

12. 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 provided with off-normal contacts, an impulse relay normally connected to said incoming line responsive to impulses from a distant point, brushes for said switch normally disconnected from said incoming line, a controlling relay operative to disconnect said incoming line from said impulse relay and to extend it to the brushes of said switch, a slow acting relay operated by said impulse relay to control the release of said switch, a primary motor magnet, a circuit therefor controlled at said slow acting relay, said controlling relay and said impulse relay, a change-over relay in series with said primary motor magnet, a secondary motor magnet for said switch, and a circuit for said secondary motor magnet controlled at contacts of said controlling relay, said impulse relay, said change-over relay and said off-normal contacts.

In witness whereof, I hereunto subscribe my name this 22nd day of July, A. D. 1919.

WINFRED T. POWELL.