

June 30, 1931.

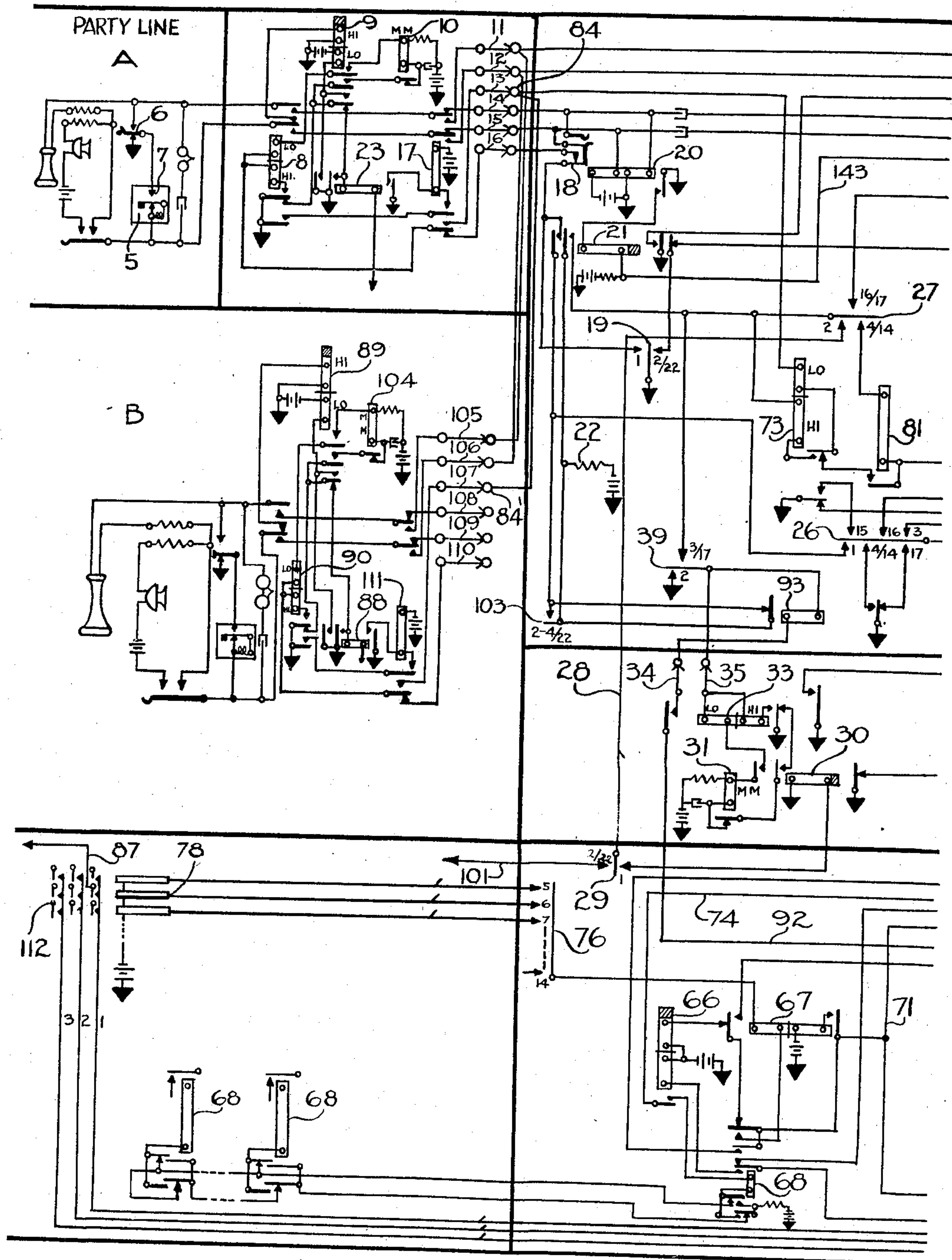
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1,812,641

REMOTE CONTROL MAGNETO TELEPHONE SYSTEM

Filed May 31, 1930

3 Sheets-Sheet 1



AUTOMATIC OFFICE

FIG. 1

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June 30, 1931.

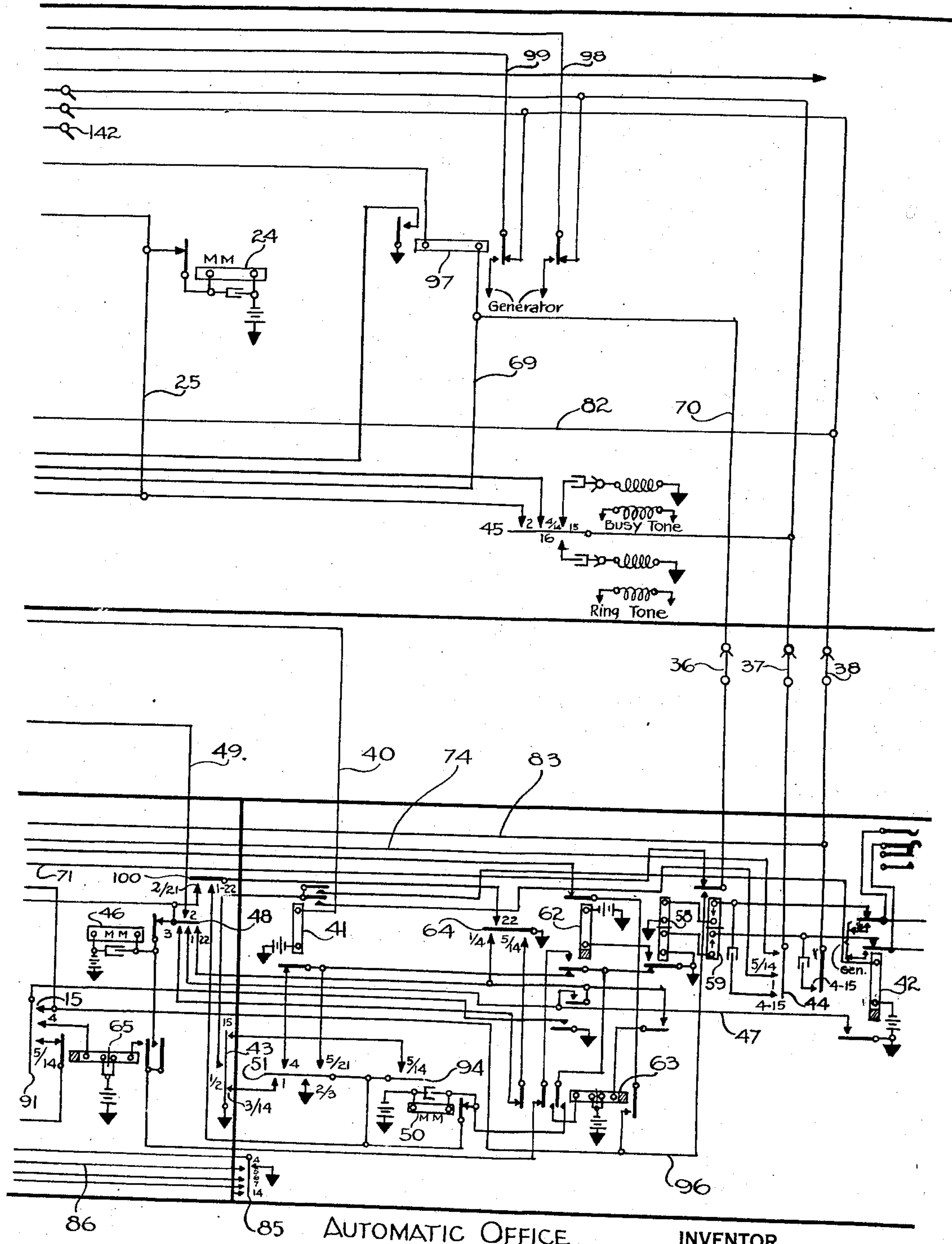
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REMOTE CONTROL MAGNETO TELEPHONE SYSTEM

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3 Sheets-Sheet 2



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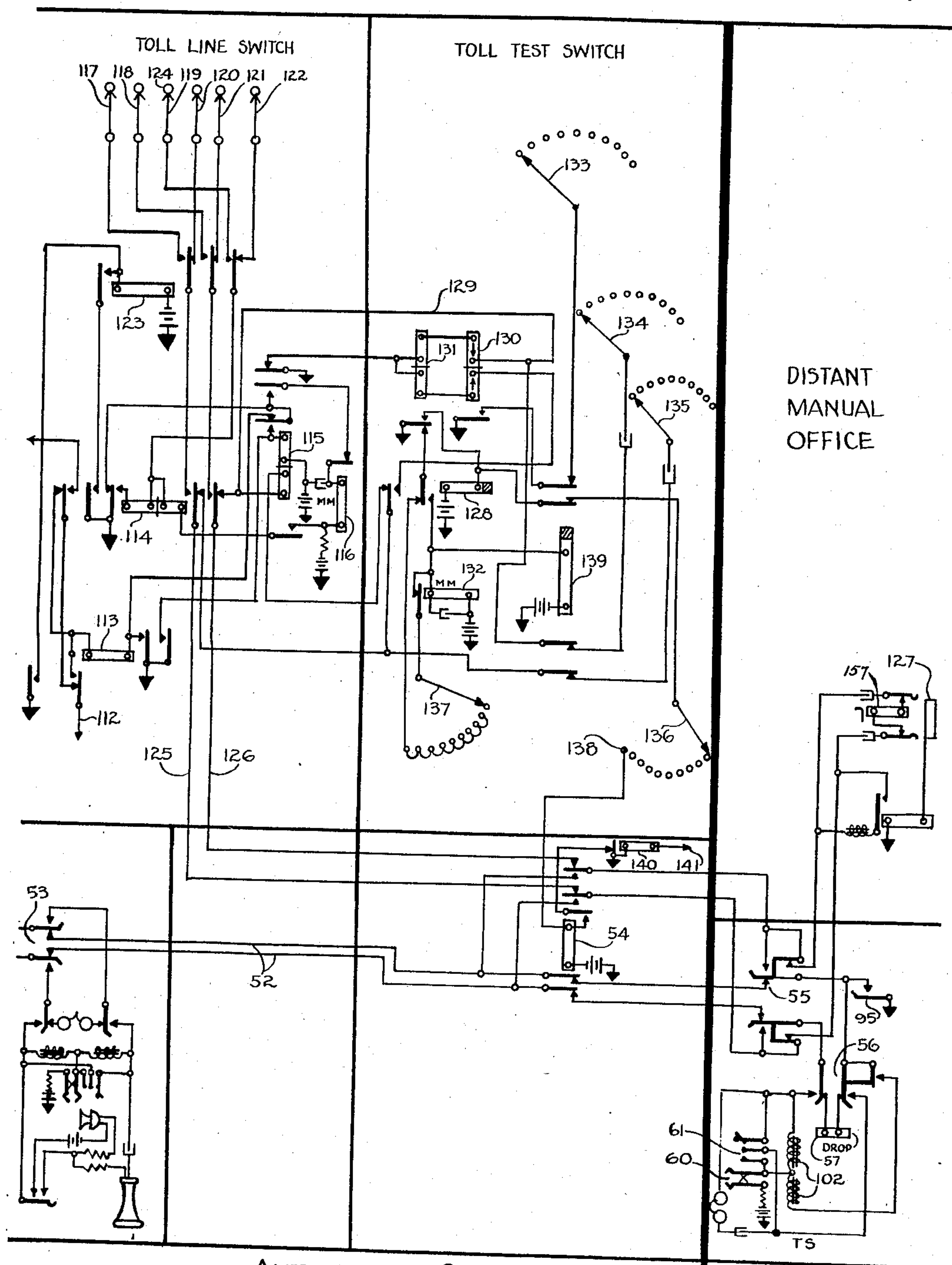
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REMOTE CONTROL MAGNETO TELEPHONE SYSTEM

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3 Sheets-Sheet 3



AUTOMATIC OFFICE
FIG. 3

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REMOTE CONTROL MAGNETO TELEPHONE SYSTEM

Application filed May 31, 1930. Serial No. 457,826.

This invention relates to telephone systems and more particularly to remotely controlled magneto telephone systems.

One feature of the present arrangement is directed to such a remotely controlled telephone system in which the outlets from the subscriber's line switches are greatly increased without a corresponding increase in the size of these line switches. Another feature of the invention resides in the arrangement whereby a subscriber on a party line may signal another subscriber on this line without requiring the services of an operator.

Other features of the invention will appear from the detailed description and appended claims when taken with the drawings in which Figs. 1, 2, and 3 when placed in the order named diagrammatically represent a portion of a telephone system including the present invention.

It is believed that the invention will best be understood by describing the method of establishing a telephone connection from a calling substation such as A to a called substation such as B. The calling party at substation A initiates a call by turning the handle of the hand generator indicated at 5, to complete a circuit from the ground at key 6, contacts 7 of the generator now closed, winding of the generator, upper armature and back contact of switching relay 8, high-resistance winding of the slow releasing line relay 9 to ground. Alternating current developed by the generator in this circuit operates the line relay 9 which on operation closes a locking circuit for itself from grounded battery, low resistance winding of this relay, its lowermost front contact and armature, inner back contact and armature of switching relay 8 to ground. With the line relay operated, an energizing circuit for the motor magnet of the line switch, is completed from grounded battery, through the resistance unit, winding, back contact and armature of this magnet, front contact and armature of relay 9, back contact and armature of relay 8 to ground. Under the control of this circuit the line switch steps its brushes until the test brush 16 encounters the

test terminal of an idle bridge circuit which terminal is characterized by the presence of ground potential. During the time that the motor magnet 10 is operating, a test circuit is extended to the test brush 16 from grounded battery, resistance unit, innermost front contact and armature of relay 9, low resistance winding of switching relay 8, armature and back contact of relay 17 and thence to test terminal 16. As soon as the first idle bridge circuit test terminal is encountered, which is assumed to be that represented in Fig. 1, this test circuit is completed through the test brush 16 and the test terminal of this bridge circuit, normally closed contacts 18, brush 19 of the bridge sequence switch in position 1 to ground.

The switching relay 8 is operated over this circuit, and closes an energizing circuit for the holding relay 20 over two sides of the bridge circuit in series, line switch brushes 14 and 15, back contacts and armatures of relay 17, front contacts and armatures of the switching relay 8, and thence over the two sides of the calling line in series. Relay 20 is thus operated and closes an energizing circuit for the slow releasing relay 21. With the relay 21 energized the sequence switch is advanced into position 2 in a circuit from grounded battery, winding, armature and back contact of motor magnet 24, sequence switch brush 26 in position 1, armature and front contact of relay 21, sequence switch brush 19 in position 1 to ground. During the interval that these operations are taking place, the switching relay 8 is held operated at the armature and front contact of the slow releasing relay 9. When, however, the sequence switch reaches position 2 a holding circuit for the switching relay 8 is completed from ground at its inner armature and front contact, its high resistance winding, armature and back contact of relay 17, test brush 16, contacts 18, armature and front contact of relay 21, sequence switch brush 103 closed in position 2, resistance unit 22, to grounded battery. As long as the line relay 9 is energized it holds open a break point in the operating circuit of the terminating test relay 23, so that the calling

line A tests busy and when the line relay degenerizes the circuit of relay 23 is then held open at the inner armature and back contact of the switching relay 8.

5 In position 2 of the sequence switch the common starting wire circuit is completed to cause an idle finder switch with its associated register sender to be associated with the bridge circuit taken for use. This circuit extends from grounded battery, resistance unit 22, inner armature and front contact of relay 21, sequence switch brush 27 in position 2, starting wire 28 register brush 29 in position 1, winding of the slow releasing relay 30 to ground. This circuit operates the relay 30 of the first idle finder switch in the sequence which is assumed to be that finder represented in Figs. 1 and 2. With the relay 30 energized the motor magnet 31 of this finder is operated from grounded battery, the resistance unit, winding, back contact and armature of magnet 31, armature and front contact of relay 30, back contact and armature of switching relay 33 to ground. Under the control of this circuit, the motor magnet 31 advances the brushes 34 to 38 inclusive until the test brush 35 encounters the test terminal associated with the bridge circuit taken for use. When this takes place, the switching relay 33 is energized from grounded battery, the resistance unit, outer armature and front contact of relay 30, low resistance winding of the relay 33, test brush 35, sequence switch brush 39 in position 2 to ground. With the relay 33 energized, the operating circuit of motor magnet 31 is interrupted, so that the brushes of the finder switch are stopped in engagement with the terminals of the bridge circuit under consideration. Relay 33, at its right hand armature and front contact closes a circuit from ground over conductor 40 for operating the relay 41. Relay 41 in turn effects the operation of the slow releasing ringing relay 42 from grounded battery, winding of this relay, uppermost front contact of relay 41, units register brush 43 to ground. The relay 41 also completes a circuit for moving the bridge sequence switch out of position 2 into position 3, which circuit is completed from ground, units register brush 43 in position 1, inner armature and front contact of relay 41, tens register brush 44 in position 1, finder brush 37, bridge sequence switch brush 45 in position 2, conductor 25, back contact, armature and winding of the motor magnet 24 to grounded battery.

60 The operation of the relay 42 closes a circuit for advancing the units register into position 2 which circuit extends from grounded battery, winding, armature and back contact of motor magnet 46, units register brush 48 in position 1, conductor 47

front contact and lower armature of relay 42 to ground.

As soon as the units register leaves position 1, the start wire 28 is disconnected from the relay 30 and is extended to conductor 101. This causes the relay 30 to degenerize whereupon the units register is moved into position 3 over a circuit, from grounded battery, winding, armature and back contact of motor magnet 46, register brush 48, back contact and armature relay 30 to ground. The tens register is now advanced into position 2 over a circuit traceable from grounded battery, winding, back contact and armature of the motor magnet 50, tens register brush 51 in position 1, units register brush 43 in position 3, to ground. This advances the tens register to 2 and it is then moved into position 4 in a circuit completed to ground at brush 51.

At the time when the ringing relay 42 is operated, uninterrupted generator current is applied through the upper front contacts and armatures of relay 42, back contacts of the emergency key 53, armatures and back contacts of relay 54, normal contacts of the transfer key 55, normal contacts of dial key 56, winding of the drop 57. This drop is thus operated and indicates to the operator that a call is awaiting extension. It will be understood, however, that the drop 57 may be replaced by a relay and a lamp actuated thereby in accordance with the common line relay and line lamp arrangement now employed in common battery telephone systems.

The generator current is applied momentarily to the drop giving in effect a "splash" ring to the operating trunk 52. As soon as the units register is advanced to position 3, as above described, the brush 43 interrupts the operating circuit of the relay 42, so that the generator is disconnected from the trunk 52. At the same time the relay 42 completes the impulse circuit to be described.

The operator now presses the dial key 56 which is effective to connect the dial of the telephone set TS to the trunk 52. The release of the relay 42 connects the ground through both windings of the impulse relay 58 through both windings of the differentially wound relay 59 in multiple over a simplex circuit including both sides of trunk 52, both windings of impedance coil 102 to grounded battery. This circuit is effective to operate the impulse relay 58, which in turn operates the slow releasing relay 62, but the relay 59 which is differentially connected in the circuit is not energized at this time. When the impulse relay 58 is energized it closes an operating circuit for the slow releasing change-over relay 63, from grounded battery, winding of this last-named relay, lowermost armature and front contact of the impulse relay, units register

brush 64, to ground. The operator now converses with the calling subscriber to ascertain the number of the wanted line and then proceeds to operate her dial including the impulse springs 60 and the shunt springs 61 to set up this number on the tens and units registers.

Let it be assumed that the designation of the wanted line is 12—4 rings. It will be recalled that the bridge sequence switch is in position 3 at this time, the tens register in position 4 and the units register in position 3. The operator actuates the dial thus opening the impulse springs 60 to send one impulse corresponding to the #1 digit. This interrupts the simplex circuit including the impulse relay 58 which releases the impulse relay 58 which at its armature and back contact, closes an operating circuit for the tens motor magnet 50 from grounded battery, winding of magnet 50, front contact and armature of change-over relay 63, back contact and armature of impulse relay 58, to ground. This causes the motor magnet to advance its register into position 5. At the close of the tens series of impulses, the impulse relay 58 holds its armature attracted for a relatively long interval which cause the slow releasing change-over relay 63 to degenerize. When the change-over relay 63 degenerizes it completes an operating circuit for moving the units register into position 4, which circuit extends from grounded battery, winding, armature and back contact of motor magnet 46, brush 48 in position 3, outermost back contact and armature of relay 63, tens register brush 64 in position 5, to ground. The units change-over relay 65 is now energized from grounded battery, its left hand winding, brush 91 in position 4, lowermost front contact and armature of slow releasing relay 62 to ground.

The operator now actuates the dial impulse springs 60 to transmit two impulses, corresponding to the units series of impulses. In response to each of these impulses, the impulse relay 58 retracts its armature and thereby closes an energizing circuit traceable from ground, its inner armature and back contact, armature and front contact relay 62, armature and back contact of relay 63, armature and front contact of relay 65, winding of the units register motor magnet 46 to grounded battery. In response to each of these two impulses the units register brushes are advanced two steps to bring them into position 6. It will be noted that the units change-over relay 65, which is slow releasing, is locked operated from grounded battery through its right hand winding, front contact and armature, in multiple with the operating circuit of the motor magnet 46.

At the close of the units series of impulses, the impulse relay 58 is held operated

for a relatively long interval which permits the units change-over relay 65 to degenerize. When this takes place, the slow releasing busy test relay 66 is operated from grounded battery, winding of this relay, back contact and armature of relay 67, uppermost back contact and armature of relay 68, back contact and armature of relay 65, units register brush 91 in position 6, lowermost front contact and armature of relay 62 to ground. Relay 66, when thus energized, closes a break point in the operating circuit of the relay 68. At this time also the motor magnet 24 of the bridge sequence switch is operated to advance the sequence switch brushes into position 4, this circuit being completed from grounded battery, winding, armature and back contact of the motor magnet 24, sequence switch brush 26 in position 3, conductors 69 and 70, finder brush 36, armature and back contact of relay 59, conductor 71, armature and back contact of relay 65, unit register brush 91 now in position 6, front contact and armature of relay 62 to ground.

In position 4 of this sequence switch a circuit is closed from ground at the armature and back contact of relay 73, sequence switch brush 45 in position 4, brush 37, tens register brush 44 in position 5, conductor 74, armature and front contact of relay 66, winding of relay 68, its continuity spring and back contact, thence through the back contacts and continuity springs of other relays 68 of other register units, through the resistance unit, to grounded battery.

If only one operating trunk is used, the first-mentioned relay 68 will be immediately operated, but if more than one such trunk is provided, relay 68 will operate only when the operating trunk here represented is the only one making the test. This sequence arrangement through the contacts of the several relays 68 is to prevent errors which would arise if more than one operating trunk was making the test to a wanted line at the same time.

When relay 68 is operated, it closes a locking circuit for itself through its inner armature and continuity spring, so that it is held operated independently of the other relays such as 68. Also when the relay 68 is operated, it closes a circuit from ground at the lower armature and front contact of relay 62, the units register brush 91 in positions 5 to 14, back contact and armature of relay 65, upper armature and front contact of relay 68, winding of relay 67, units register brush 76 in position 6, winding of relay 78 to grounded battery. This circuit operates the relay 78 and the relay 67. Relay 67 is locked operated through its right hand winding, front contact and armature, armature and back contact of relay 65, units register brush 91 in positions 5 to 14, front con-

tact and armature of relay 62 to ground. This circuit insures that the relay 67 is held operated until the units register advances to position 15.

5 With the relay 68 operated, relay 81 of the bridge is energized in a circuit closed from grounded battery, resistance 22, armature and front contact of relay 21, sequence switch brush 27 in position 4, winding of re-
10 lay 81, conductor 82, finder brush 38, conductor 83, middle front contact and armature of relay 68, units register brush 91, lower front contact and armature of relay 62 to ground. Relay 81 is thus operated and
15 applies ground potential over conductor 82 previously referred to, armature and front contact of relay 81, back contact, continuity spring and low resistance winding of relay 73 to the terminating test terminal such as
20 84 and 84' of the bridge circuit now in use, so that the called line switch will seize the called end of this bridge.

At this time a circuit is closed from grounded battery, winding of the relay 66, front contact and armature of relay 68, tens register brush 85 in position 5, conductor 86, front contact and armature of the relay 78 which is common to all lines having the units digit #2, conductor 87
30 which is the test conductor individual to the called line 12, winding of the terminating test relay 88 of the called line, back contacts and armatures of the line relay 89 and the switching relay 90 to ground. This circuit maintains the relay 66 energized and
35 operates the relay 88 of the called line and this last-named relay closes a locking circuit for itself through its front contact and armature which circuit is independent of the relays 89 and 90.
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With the relay 88 operated, the line relay 89 of the called line switch is operated, whereupon the motor magnet of this line switch is energized from grounded battery, resistance unit, winding, back contact and armature of the motor magnet, front contact and armature of relay 89, back contact and armature of the switching relay 90 to ground. Under the control of this circuit,
45 the motor magnet advances the line switch brushes 105 to 110 inclusive, until the test brush 107 encounters test terminal 84' of the called end of the bridge circuit which has been seized by the calling line, at which
50 time relay 90 is operated. On the operation of this relay, it closes a locking circuit for itself from ground, its armature, front contact and high resistance winding, armature and front contact of relay 111, test brush
55 107, test terminal 84', upper winding of relay 73, its continuity spring and armature, its high resistance winding to grounded battery. With the switching relay 90 operated, the relay 111 is locked operated through its
60 inner front contact and armature.
65

When relay 73 is operated as described above, at its lowermost armature and back contact, it interrupts the circuit which has been holding the relay 68 of the units register operated. This relay then releases and completes a circuit from ground, at the lower armature and front contact of relay 62, units register brush 91, back contact and armature of relay 65, armature and back contact of relay 68, left hand armature and front contact of relay 67, back contact, armature and winding of the units register motor magnet 46, to grounded battery. Under the control of this circuit the units register is advanced to position 15 in which position the relay 67 is released. Also in position 15 of this register, a circuit is completed from ground, armature and front contact of relay 33, finder brush 34, winding of relay 93, sequence switch brush 39 in position 4, front contact and armature of relay 21, resistance unit 22, to grounded battery. This circuit energizes the relay 93 which extends a circuit from ground, sequence switch brush 26 closed in anyone of its positions 4 to 14, back contact, armature, and winding of the motor magnet 24 of the sequence switch, to grounded battery. This advances the bridge sequence switch to position 15. A circuit is now closed from ground at the armature and front contact of the relay 73, sequence switch brush 26 in position 15, back contact and armature, and winding of the motor magnet 24 which operates to advance the sequence switch into position 16.
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85
90
95
100

When the units register is advanced to position 15 as above described and the relay 67 degenerizes, the circuits of the relay 66 are opened, first at units register brush 91 and then at the common test relay 78 which opens the called line test circuit extending through the normally open contact of relay 68. Relay 66 then releases and in turn causes the release of the relay 68 which is effective to close a circuit from ground at units register brush 43 in position 15, and tens register brush 94, armature, back contact and winding of the tens motor magnet 50 which advances the brushes of the tens register into position 15.
105
110
115

It is assumed that the called line tested idle and that the bridge sequence switch advanced into position 16 as above described, where a ringing tone is applied through brush 45, finder brush 37, tens register brush 44 in position 15, back contact and armature of relay 42, normal contacts of the emergency key 53, upper trunk conductor 52, and thence to the operator's head telephone TS where the tone is heard. This is an indication to the operator that the apparatus is in condition for operating the ringing key 95. The foregoing operations following the setting of the units register takes place in a
120
125
130

very short time but nevertheless the operator should not operate the ringing key until this ringing tone is applied. While the apparatus would not be falsely operated under such a premature depression of the ringing key, nevertheless, it might be possible for her to apply the first portion of the ringing code before the sequence switch has reached the ringing position thus applying the wrong ringing code to the called line.

The operation of the ringing key 95 connects ground to the tip conductor of the trunk 52 which is effective to unbalance the differentially wound relay 59 causing it to attract its armature. The impulse relay 58, however, is maintained operated over the lower ringing conductor 52 of the trunk.

When the relay 59 operates, it closes a circuit from ground, armature and front contact of relay 62, units register brush 91, now in position 15, conductor 96, front contact and armature of relay 59, finder brush 36, conductor 70, winding of relay 97, sequence switch brush 27 in position 16, front contact and armature of relay 21, resistance unit 22 to grounded battery. This circuit operates the relay 97 which in turn closes a circuit for advancing the sequence switch into position 17 from ground at the armature and front contact of relay 97, sequence switch brush 26 in position 16, conductor 25, back contact, armature and winding of the motor magnet 24 to grounded battery. In position 17, current from the ringing generator is applied through the front contacts and armatures of relay 97, to the tip and ring conductors 98 and 99 now connected to the called line. The relay 97 is maintained operatable so that continued or intermittent operation of the ringing key 95 is effective to operate it to apply the proper code signaling to the called telephone line.

During this time the operator's telephone sets TS is extended to the connection so that she may advise the calling subscriber that the called party does not answer. If and when the called subscriber does answer, the operator restores the dial key 56 to release the relays 58 and 62. This is effective to advance the tens register into position 22 since an operating circuit is closed for the tens motor magnet 50, from grounded battery, winding, back contact and armature of this magnet, brush 51 in positions 5 to 21 inclusive, back contacts and armatures of relay 62 and 58 to ground. With the tens register in position 22, the units register is likewise advanced to position 22 in a circuit traceable from grounded battery, winding, armature and back contact of magnet 46, units register brush 100 in positions 2 to 21 inclusive, units register brush 64 in position 22 to ground. Under the control of this circuit the units register is advanced to position 22 whereupon the tens register is

advanced to normal position over a circuit closed from grounded battery, winding, back contact and armature of magnet 50, units register brush 100 in position 22, tens register brush 64 in position 22 to ground. The units register is now moved to normal position in a circuit extending from grounded battery, winding, armature and back contact of the units magnet 46, units register brush 48 in position 22, tens register brush 64 in position 1 to ground. When the units register brush 91 leaves position 15, relay 93 is degenerized thereby closing a circuit for advancing the bridge sequence switch into position 18. This circuit extends from grounded battery, winding of the motor magnet 24, its armature and back contact, sequence switch brush 26 in position 17, back contact and armature of relay 93 to ground. When the sequence switch brush 39 leaves position 17, the holding circuit for the switching relay 33 of the finder switch is opened causing it to degenerize thereby placing the register unit and its associated finder in normal condition ready for use in establishing a succeeding connection.

With the sequence switch in position 18 which is the talking position the connection is completed between the calling and called subscribers and this connection is maintained until the calling subscriber hangs up his receiver which is effective to release the relays 20 and 21. This releases the calling and called line switches and the sequence switch of the bridge used in this connection is restored to normal in a circuit closed from grounded battery, winding, armature and back contact of magnet 24, back contact and armature of relay 21, sequence switch brush 19 closed in anyone of its positions 2 to 22 inclusive, to ground.

If the called line B is busy at the time when the test of the called line is made over its test conductor 87 (Fig. 1) this test circuit will not be completed because it will be opened at the back contact and armature of relay 90. Therefore, the relay 66 of the units register will be released just after the operation of relay 68 because there is no ground potential from the test conductor 87 of the called line extended through tens register brush 85 for maintaining the relay 66 operated. The units register is now advanced to position 15 wherein the relay 93 of the bridge is operated for advancing the sequence switch to 15, also since the called line is busy, it is not connected to the terminating terminal of the bridge circuit in use and relay 73 is not energized. This prevents the sequence switch from leaving position 15 and the busy tone is extended to the calling line through the sequence switch brush 45 in position 15. At the same time the busy tone is applied to the operating trunk through the finder brush 37 to

tens register brush 44 in position 15 and through the condenser to the upper side of the operating trunk. It will be noted at this time that the bridge sequence switch, the tens register and the units register are all in position 15. On receiving this busy signal the calling subscriber replaces his receiver on its switch hook which degenerates the bridge relay 20 and in turn the slow-releasing relay 21 which is effective to restore all the equipment to normal condition.

It will now be assumed that the calling subscriber A instead of desiring a telephone connection to a line terminating in the same exchange as his own, desires to make a long distance call to a telephone line which may be reached through any one of several distant exchanges. It is further assumed that the No. "05" is assigned to the trunk or trunks leading to one such distant office and that the No. "01" is assigned to trunks leading to another distant office. In the case of such a long distance call, the subscriber at A initiates a call by operating the hand generator whereupon the line switch of the calling line seizes a bridge circuit which may be the one previously referred to in the case of the local call. An idle finder switch which may be the one herein disclosed associates with this bridge the idle register unit together with the operating trunk such as 52 to the operator's telephone set TS. At the distant exchange, when this takes place, the operator receives a "splash" ringing signal to inform her that a call is awaiting attention. When the operator ascertains that the No. "05" is desired, she operates the impulse contacts 60 of the dial associated with her telephone which is effective to operate the register sender which in turn applies test potential to the test wire associated with the first idle toll trunk leading to the desired distant exchange. When this number is set up on the tens and units register of the selected sender, test potential is applied from the register sender through the armature and front contact of one of the test relays, conductor 112 of Fig. 1, which is a part of conductor 112 of Fig. 3, continuity spring and back contact of terminating test relay 113, armature and back contact of switching relay 114 of the toll line switch, winding of relay 113, back contact and armature of relay 115, back contact and armature of relay 114 to ground. Relay 113 is thus energized and closes a locking circuit for itself through its inner right hand armature and front contact to ground. At the outer left hand armature and front contact of relay 113, relay 123 is operated. Also at the right hand armature and front contact, an energizing circuit is completed from ground through the upper winding of relay 115 to grounded battery which energizes this relay and

closes an operating circuit for the motor magnet 116 from grounded battery, resistance unit, winding, armature and back contact of this magnet, middle armature and front contact of relay 115, inner back contact and armature of relay 114 to ground. Under the control of this circuit the motor magnet of the toll line switch advances its brushes 117 to 122 inclusive until the terminating end of the bridge circuit leading to the calling line is found, at which time the switching relay is actuated from grounded battery, the resistance unit, lower, front contact and armature of relay 115, right hand winding of relay 114, outer armature and front contact of relay 123, test brush 119, test terminal 124 of the wanted bridge to ground. This energizes relay 114 which opens the operating circuit of the motor magnet 116 and closes a locking circuit for itself from ground at its inner armature and front contact, and its winding, to grounded battery, through the line switch brush 119 which is subsequently connected to grounded battery, as in the case of a local terminating call previously described.

The operator now depresses the ringing key 95 which is effective to operate the relay 97 of Fig. 2 to apply ringing current to the seized bridge. This ringing current is applied to the terminating end of this bridge and through the toll line switch brushes 117 and 118 and thence over conductors 125 and 126 to the drop 157. This drop is thus actuated and the toll operator who may also function as a dialing operator inserts the answering end of a cord circuit (not shown) into the jack 127 of this toll circuit. The calling end of this cord circuit is now connected to the wanted line at the distant exchange, and the dialing key 56 is now restored whereupon the register sender equipment reverts to common use.

A disconnect signal on this last mentioned connection is effected by applying ringing current to the answering toll cord by the calling subscriber ringing off while the disconnect signal is applied to the calling toll cord by the called subscriber operating his hand generator to give the ring-off signal. A generator current is thus applied through the condensers in the bridge circuit and the brushes 117 and 118 of the toll line switch and thence by way of conductors 125 and 126 to the ring-off drop associated with the cord circuit.

In the event that the toll operator received a call for a subscriber whose line terminated in the exchange where the automatic switches are located, she inserts the calling plug of a cord circuit (not shown) into the jack 127 of an idle toll trunk and depresses the ringing key associated with that cord circuit which is effective to energize the relay 115 of the toll line switch. The circuit of this re-

lay extends from generator associated with the calling cord, tip and ring contacts of jack 127, condensers, normally closed contacts of transfer key 55, upper armatures and back contacts of relay 54, conductors 125 and 126, right hand armatures and back contacts of relay 114, left hand armature and back contact of relay 128 and lower winding of relay 115. Relay 115, when thus operated, completes a locking circuit through its upper winding, its upper front contact and armature to ground, at the back contact and armature of relay 114. The operation of relay 115 closes an operating circuit for the motor magnet 116 which now advances the toll line switch brushes 117 and 122 inclusive until the test brush encounters the test terminal 124 of the originating end of an idle bridge circuit.

When the toll line switch seizes a bridge circuit as just described a register unit and its associated operating trunk is connected to the seized bridge circuit and the drop 57 will be actuated over the operating trunk as in the case of a local call. The dialing operator depresses the dialing key 56 and obtains the number of the wanted subscriber, whereupon she sets up this number in the seized register sender by operating the dial impulse springs 60. This causes the called subscriber's line switch to seize the terminating end of the bridge circuit after which the called subscriber is rung by depressing the key 95, all as previously described. When the called subscriber answers, the dial key 56 may be restored after which the operating trunk and associated equipment reverts to common use. This connection now extends through the operator's toll cord circuit, through the toll line switch, originating end of the bridge, terminating end of the bridge, and thence through the called line switch to the called line.

When the called subscriber rings off, generator current is extended through the condensers of the bridge circuit and by way of the toll switch brushes to the toll trunk and thence through the condensers associated with the toll jack 127 to the calling cord circuit (not shown). This is effective to operate the ring-off drop whereupon the toll operator removes the calling cord from the trunk jack 127 thereby opening the circuit of relay 20 of the bridge circuit which degenerizes thereby causing the restoration of the equipment to normal condition.

It may happen that the operating trunk 52 between the dialing operator's position at the remote control office and the automatic office becomes temporarily inoperative. In such an emergency the dialing operator may control the apparatus at the automatic exchange over the toll trunk instead of over the operating trunk. It will be understood that if desired more than one toll trunk

may be provided with this feature. It will be noted in Fig. 3 that the toll trunk is provided with a toll test switch in addition to the toll line switch. Normally this toll test switch is only used for testing purposes such as supervising and monitoring the bridge circuits. When the toll trunk is used in the regular manner, that is by means of generator current applied to the trunk, the toll line switch functions to select a bridge circuit as above described. When, however, the operator depresses the transfer key 55, the toll line switch is not operated, but the toll test switch is operated to select numbers as set up by the operation of the dial springs 60. The operation of the transfer key 55 associated with the toll trunk interrupts the operating trunk 52, and transfers the dial equipment including the impulse springs 60 and the operator's telephone from the operating trunk 52 to the toll trunk including conductors 125 and 126. The operator then actuates the impulse springs 60 to dial a special number such as No. "9". Now with the transfer key 55 operated, a circuit is extended from grounded battery, through the impulse springs 60 and through the impedance coils 102 through the upper armatures and back contacts of relay 54 and over conductors 125 and 126 of the toll trunk in multiple, armatures and back contacts of switching relay 114 and in series to the lower winding of relay 115. Relay 115 is not operated at this time since the simplex circuit is not completed. A branch of this circuit extends from conductor 126, armature and back contact of relay 114, conductor 129, upper winding of relays 130 and 131, upper back contact and armature of relay 115 to ground. Another circuit is extended over conductor 125, armature and back contact of relay 114 to the outer armature of relay 128. Relay 128 is energized, however, as soon as the relay 131 is operated. With the relays 128 and 131 operated the operator may now dial the special No. "9" and in response to these impulses the relay 131 retracts its armature to complete an operating circuit for the motor magnet 132 of the toll test switch, from grounded battery, winding of this magnet, front contact and armature of relay 128, back contact and armature of relay 131 to ground. Under the control of this circuit the toll test switch advances its brushes 133, 134, 135, 136 and 137 nine steps until the brush 136 engages contact 138. During the time that the motor magnet 132 is operating, relay 128 and the slow-releasing change-over relay 139 are energized until the dial operation is stopped. Then relay 139 degenerizes and closes an operating circuit for the relay 54 from grounded battery, its winding, contact 138, brush 136, back contact and armature of relay 139 front

contact and armature of relay 131 to ground. Relay 54, on operating, closes a locking circuit for itself from grounded battery through its winding, front contact and
 5 armature, back contact and armature of relay 140 to ground. With relay 54 thus locked operated the register sender is disconnected from the operating trunk and connected to the toll trunk. The relay 54
 10 also disconnects the toll line switch and the toll test switch from the toll trunk. When this switch takes place relays 131 and 128 release and restore the test switch to normal. In this way the toll trunk is substituted for
 15 the operating trunk since the transfer is made at both ends.

The dialing operator may now control the connections at the automatic exchange over the toll trunk in the same manner as over
 20 the operating trunk. When the operating trunk is ready for use, it is restored to service under the control of the dialing operator, by the transmission from the impulse springs 60 of the dial of a special No. such
 25 as "00" to the register sender which is effective to complete a test circuit from this sender through the contacts of some one of the test relays such as 78 over the test conductor 141 shown in Fig. 3 and including the
 30 winding of relay 140. The relay 140 is thus operated and immediately causes the release of relay 54 which reconnects the toll trunk to the toll line switch and toll test switches. The operator may now restore the transfer
 35 key 55 whereby the toll trunk is connected to the contacts of its jack 127. Service may now be handled over the operating trunk. The release of relay 54 disconnects the battery which was connected to the register unit
 40 from the dial key 56 by way of the front contact of transfer key 55 so that the register and bridge circuits are now restored to normal.

Reference has been made to the use of the
 45 toll test switch for supervising and monitoring the bridge circuits. This switch is operated in the manner previously described, after the operator has depressed the transfer key 55 and the dial key 56 by the dial
 50 springs 60. While the dial is being operated, the conductors of the trunk are held disconnected from the brushes 134 and 135 at the armatures and back contacts of relay 139. It will be understood that the digits, 1
 55 to 8, may be used for setting the test switch into connection with the corresponding bridges, but the digit No. 9, however, may not be used since it is utilized for substituting the operating trunk for the toll trunk. When more than eight bridges are employed,
 60 two digit numbers beginning with "0" are used to set the test switch into connection with these additional bridge circuits. The number "0" is not used for this purpose, but
 65 the number "00" may be so used, so that a

total of eighteen test connections with as many bridges may be effected at the toll test switch. If after the operator has monitored a connection, she finds that it is not being
 70 used for conversation, she depresses the key 95 which serves both for ringing and release purposes. The depression of this key is effective to unbalance the relay 130 of the test switch which energizes and completes a
 75 circuit from ground at the front contact and armature of relay 130, back contact and armature of relay 139, brush 133 to terminal 142 of Fig. 2, conductor 143, resistance unit to grounded battery. This circuit is effective
 80 to short-circuit and release relay 21 which in turn controls the release of the operating equipment to its normal condition.

If the operating trunk and the toll trunks between the distant manual office and the automatic office are all disabled as may hap-
 85 pen in the case of a storm, provision is made whereby an emergency telephone at the automatic office may be connected through the contacts of the emergency key 53 to the portion of the operating trunk located in the
 90 automatic office. By this arrangement, when emergency key 53 is actuated, the emergency operator may complete calls in the same manner as the dialing operator at the distant manual office. Under these con-
 95 ditions, the alternating current which previously actuated the drop 57 at the distant office now operates the ringer of the emergency telephone.

What I claim is:

1. In a telephone system, an automatic exchange, a plurality of telephone lines and a toll line terminating at said exchange, means including automatic switches for interconnecting said telephone lines and said toll
 105 line, means including impulse-controlled devices for effecting the operation of said automatic switches, a distant exchange including an operator's position, an operating trunk and said toll line terminating in said position, said impulse-controlled devices being
 110 normally governed over said operating trunk, and means at the automatic exchange actuated from said operator's position for transferring the control of said impulse-controlled devices from said operating trunk to said toll trunk.

2. In a telephone system, an automatic exchange, a plurality of telephone lines and a toll line terminating at said exchange, means including automatic switches for interconnecting said telephone line and said toll
 120 line, means including impulse-controlled devices for operating said automatic switches, a distant exchange including an operator's position, an operating trunk and said toll line terminating in said position an impulse sender at said position, means at said position for connecting said impulse sender to
 125 said operating trunk or said toll line, said

operating trunk being normally effective to transmit impulses from said impulse sender to said impulse-controlled devices, and means controlled over said toll line for removing said impulse-controlled devices from control of said operating trunk and connecting said impulse-controlled devices to said toll line.

3. In a telephone system, an automatic exchange, a plurality of telephone lines and a toll line terminating at said exchange, means including automatic switches for interconnecting said telephone lines and said toll lines, means including impulse-controlled devices for effecting operation of said automatic switches at a distant exchange, an operator's position, an operating trunk and said toll lines terminating in said position, an impulse sender at said position means for connecting said impulse sender to said operating trunk or said toll line, said operating trunk being normally effective to transmit impulses from said impulse sender to said impulse-controlled devices, means controlled over said toll line for removing said impulse-controlled devices from control of said operating trunk and for connecting said impulse-controlled devices to said toll line, and means controlled over said toll line for disconnecting said impulse-controlled devices from said toll line and for connecting them to said operating trunk.

4. In a telephone system, an automatic exchange, a plurality of telephone lines terminating thereat, non-numerical switches in which said telephone lines terminate, each automatic switch having a plurality of sets of terminals, a number of bridge circuits equal in number to the number of sets of terminals in said switches, each end of a bridge circuit terminating in a set of terminals at each switch, a distant office, an operator's position thereat provided with impulse sending equipment, an operating trunk connecting said automatic exchange and said operator's position, means for causing the line switch of a calling telephone line to seize one end of a selected bridge circuit, and means controlled by impulses from said impulse sending equipment transmitted over said trunk for causing the line switch of a called line to seize the other end of the selected bridge circuit.

5. In a telephone system an automatic exchange, a plurality of telephone lines terminating thereat, line switches for the use of said lines, means including bridge circuits and said line switches for interconnecting said telephone lines, a distant exchange provided with an operator's position, an operating trunk connecting said operator's position and said automatic exchange, means including said operating trunk for causing the line switch of a called line to seize a bridge circuit, an emergency telephone and controlling equipment at said automatic ex-

change whereby said automatic switches may be controlled to interconnect calling and wanted telephone lines, and means for connecting said emergency telephone and controlling equipment to said operating trunk.

In witness whereof, I hereunto subscribe my name this 29th day of May, A. D. 1930.

WINFRED T. POWELL.

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