June 2, 1925. 1,540,420

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed May 28, 1921 2 Sheets-Sheet 1

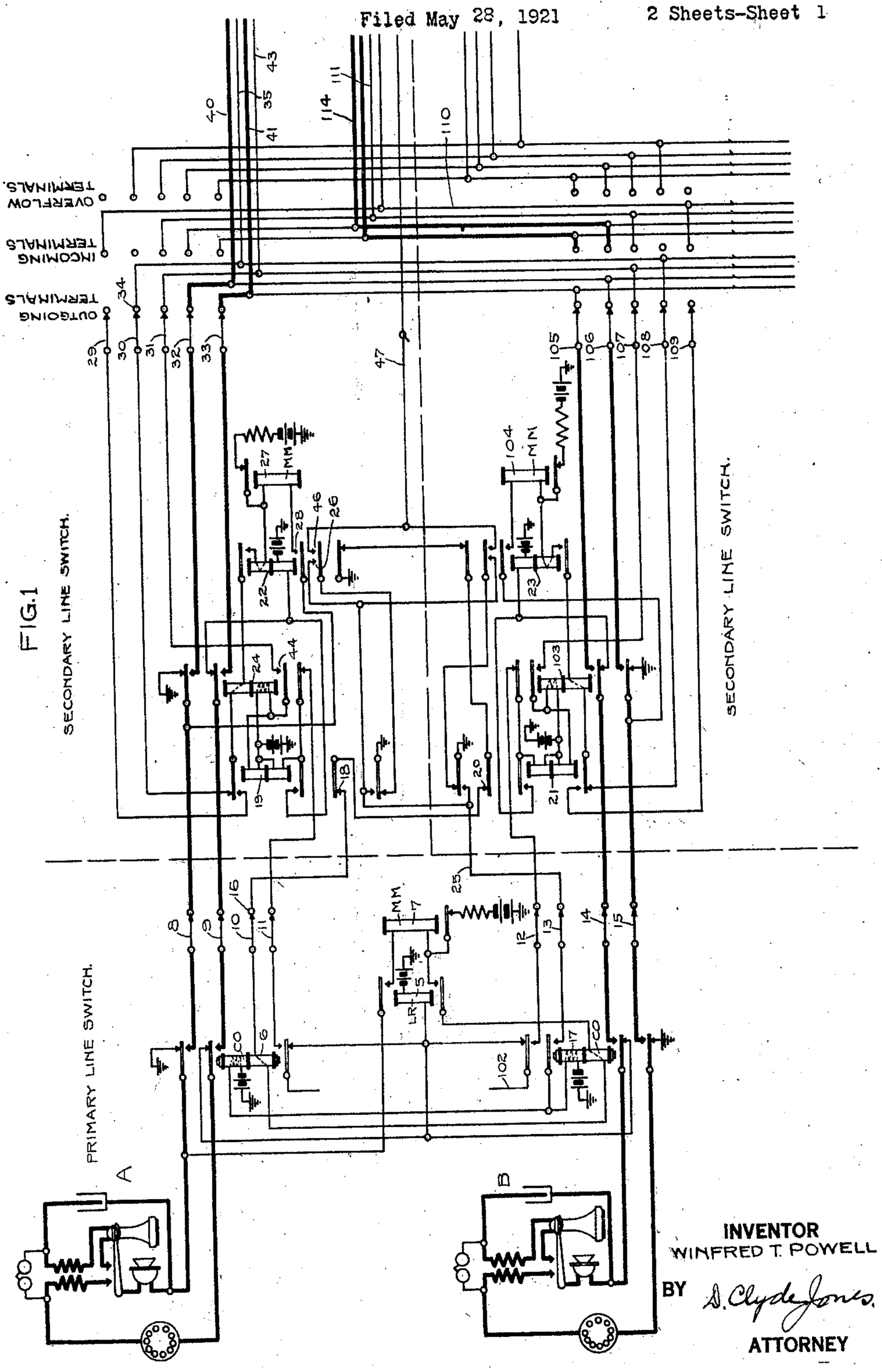

FIG. 1

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June 2, 1925.

1,540,420

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2 Sheets-Sheet 2

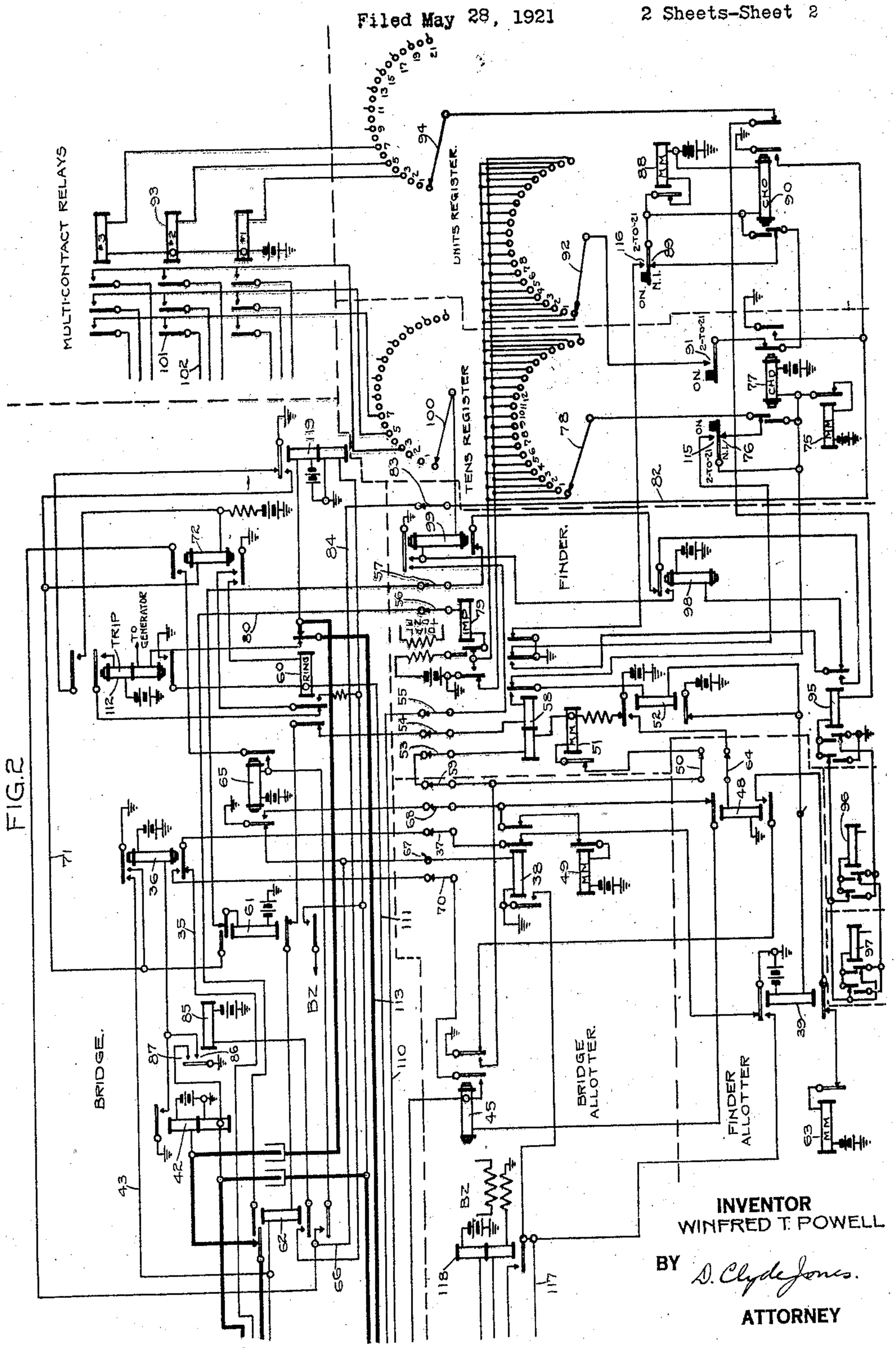

FIG.2

INVENTOR
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Patented June 2, 1925. 1,540,420

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 23, 1921. Serial No. 473,483.

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 (Case #89), of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to telephone systems employing automatic switches in establishing telephone connections.

The main features of this invention reside in novel circuits for setting automatic switches and for releasing the same. The various features will appear from the detailed description and appending claims.

The drawings with Figure 1 and Figure 2 arranged in the order named represent so much of a telephone system as is necessary for an understanding of the present invention. At the left of the dotted line of Figure 1 there are represented two substations and telephone lines leading from these substations to the brushes of a line switch individual to these two lines. At the right of this dotted line there are represented two secondary line switches which are effective to select bridge or trunk circuits. In the upper left hand corner of Figure 2 and to the left of the dotted line there is represented a bridge or trunk circuit which is comparable to an operator's cord circuit in a manual telephone system. At the left hand side of this figure there also appears a bridge allotter switch which functions to assign idle bridges for use in succession. At the upper right hand corner of this figure a group of multi-contact relays are represented while only three of these relays are shown, it will be understood that in the present system 10 such relays are employed. At the lower right hand corner a register sender comprising a tens register and a units register is shown while near the center of this figure there appears a finder switch which functions to connect its associated register sender to a selected bridge circuit. It is to be understood that there are as many register senders and associated finders as there are simultaneous calls in the process of being established. At the lower left hand-corner of this figure there is represented a finder allotter which functions to assign a finder switch and its associated register sender for use.

The switches of this system are of the so-called rotary type and may be similar to that disclosed in the patent to Clement No. 1,107,153 issued August 11, 1914, the mentioned multi-contact relays may be of any well known structure and may so be replaced by a plurality of common relays connected in multiple.

It is believed that this invention will best be understood by describing the method of establishing a telephone connection from a calling substation indicated at A to a called substation indicated at B. When the calling subscriber at A removes his receiver from its switch hook to initiate such a call, a circuit is closed for the line relay 5 from grounded battery winding of this relay, inner upper back contact and armature of the cut off relay 6 over the lower side of the calling line and through the substation circuits in series over the upper side of the calling line and through the uppermost armature and back contact of the cut off relay to ground. The line relay is actuated in this circuit and closes an operating circuit for the motor magnet 7 extending from grounded battery, resistance, back contact, armature and winding of the motor magnet 7, uppermost front contact and armature of the line relay, uppermost armature and back contact of the cut off relay 6 to ground. Under the control of this circuit the brushes 8 to 15 inclusive of the primary line switch are advanced until the test brush 10 locates a test terminal of a pair of idle trunks leading to a pair of idle secondary line switches. Let it be assumed that the first pair of idle trunks tested are those shown in Figure 1 at which time the test terminal 16 of this trunk will be characterized by the presence of ground potential indicating its idle condition. As a result of this test, the cut off relay 6 and the cut off relay 17 are operated in series in a circuit traceable from grounded battery, resistance, back contact, armature of the motor magnet 7, lower front contact and armature of the line relay 5, lower winding of the cut off relay 17, lower winding of the cut off relay 6, test brush 10, test terminal 16, contact 18 and armature of relay 19, contact 20 and armature of relay 21, up-

permost armature and back contact of relay 23, lowermost back contact and armature of relay 22 to ground. As soon as the cut off relay 6 is operated it opens its uppermost armatures and back contacts which disconnects the line relay from the calling line to effect its deenergization. At its uppermost armature and back contact it opens the operating circuit of the motor magnet 7. It will be noted that the initial energizing circuit of the cut off relay 6 and cut off relay 17 is interrupted at lower armature and front contact of line relay 5 but these cut off relays are slow releasing so that they remain energized for an appreciable interval of time thereafter. At the uppermost armatures and front contacts of the cut off relay 6 the calling line is extended through the brushes 8 and 9 of the primary line switch to ground at the uppermost armature of the relay 24 and to grounded battery through the inner upper armature and back contact of the relay 24 and lower winding of relay 22. The relay 22 is energized in this circuit and closes a holding circuit for the cut off relays 6 and 17. This circuit may be traced from grounded battery, upper windings of relays 6 and 7 in multiple, inner upper armature and front contact of relay 17, holding brush 13, holding conductor 25, contact 26 and armature of relay 22, lowermost back contact and armature of relay 19 to ground. It will be noted that the closure of the contacts of the relay 17, connects the upper winding of relay 23 in series with the selected primary trunk and the paired calling line but this circuit is incomplete at the switch hook of substation B.

As soon as the relay 22 attracts its armatures, it closes an operating circuit for the motor magnet 27 of the primary line switch shown at the upper part of Figure 1, this circuit being closed from grounded battery, resistance, back contact armature and winding of the motor magnet 27, contact 28 and armature of relay 22, uppermost armature and back contact of relay 24 to ground, and if the brushes 29 to 33 inclusive of this secondary line switch are not resting in engagement with the out-going terminals of the allotted bridge circuit, this operating circuit will actuate the motor magnet causing it to advance the brushes of the secondary line switch until its test brush 30 engages the test terminal of the allotted circuit.

Let it be assumed that the allotted bridge circuit is that appearing in Figures 1 and 2 and when the test brush 30 of the secondary line switch engages the test terminal 34 of this allotted bridge circuit the relay 24 is energized to stop the operation of the motor magnet 27. The operating circuit of relay 24 extends from grounded battery, resistance, back contact, and armature of magnet 27, upper low resistance winding of relay 22, its upper front contact and armature, upper winding of relay 24, upper armature and back contact of relay 19, test brush 30, test terminal 34, conductor 35, back contact and lower armature of slow releasing relay 36, allotter brush 37, innermost armature and back contact of relay 38, upper back contact and armature of relay 39 to ground.

At the uppermost armature and back contact of relay 24 the initial energizing circuit of the relay 22 is interrupted but this relay is now maintained operated in series with the upper winding of the relay 24 in the circuit just described, while at the armatures and front contacts of relay 24 the calling line is extended through the secondary line switch brushes 32 and 33 conductors 40 and 41 through both windings in series of relay 42 to grounded battery. Relay 42 is operated in this circuit and at its upper armature and front contact closes an operating circuit for the slow releasing relay 36. While the operation of this relay completes a holding circuit for the secondary line switch which extends from ground at the upper armature and front contact of relay 36 and conductor 43, holding brush 31, contact 44 armature and winding of relay 24 to grounded battery. At the lower armature and back contact of relay 36 the initial energizing circuit of relay 24 is interrupted with the result that relay 22 deenergizes.

As soon as the relay 22 is first operated, a circuit is closed for starting an allotted finder switch to associate its register sender with a bridge circuit which is allotted for use. This is effected by the operation of relay 45 and a circuit is closed from ground, lowermost armature and back contact of relay 19, armature and contact 46 of relay 22, conductor 47, winding of relay 45, upper armature and back contact of relay 48, outer right armature and back contact of relay 38, armature, contact, and winding of the motor magnet 49 of the bridge allotter to grounded battery. The motor magnet 49 is not operated in series with the relay 45 but this relay is caused to attract its armatures and at its outer armature and front contact closes a circuit from ground, brush 50 of the finder allotter, winding of the motor magnet 51 of the finder, through the resistance, back contact and armature of relay 52 to grounded battery. Under the control of this circuit the motor magnet 51 advances the brushes 53, 54, 55, 56, 57 and 83 of the finder switch until the allotted bridge circuit is located at which time the motor magnet 51 is shunted by a circuit closed from grounded battery, upper armature and back contact of relay 52 resistance, winding of relay 58, finder brush 53, allotter brush 59, outer front contact and armature of relay 45 to ground. This circuit stops the operation of the motor magnet 51 of the finder switch and operates relay 58. As soon as the relay 58 is oper-

ated, it closes a locking circuit for itself from grounded battery, at the lower armature and back contact of a relay similar to 52 at an idle finder switch of the series, winding of relay 52, innermost armature, front contact and right-hand winding of relay 58, finder brush 54, outermost back contact and armature of relay 60, inner lower back contact and armature of relay 61, winding of relay 62, conductor 43 to ground at the upper front contact and armature of relay 36. In the event that all the finders of the system are in use all the relays similar to 52 will be actuated so that at this time the last described circuit will extend from grounded battery through the winding of the relay 39, with the result that the relay 39 is operated to interrupt the operating circuit of the motor magnet 63 of the finder allotter to prevent its useless hunting for an idle finder switch, however, if an idle finder switch is available as soon as the relay 52 is energized, it closes a circuit from grounded battery at its upper armature and front contact, finder allotter brush 64 winding of relay 48 to ground. Relay 48 is actuated and effects the deenergization of relay 45 whereby a circuit will then be completed from ground, outer armature and back contact of relay 45, lower armature and front contact of relay 48, armature and back contact of relay 39, back contact armature and winding of the motor magnet 63 to grounded battery. Under the control of this circuit the motor magnet 63 advances the brushes 50 and 64 of the finder allotter until the brush 64 of this allotter engages the test terminal of an idle finder switch which is characterized by the absence of battery potential due to the fact that its relay 52 is deenergized. When such an idle finder is located, relay 48 deenergizes and opens the operating circuit for the magnet 63.

From the foregoing description of the advancing of the finder allotter switch it will be seen that this switch is not advanced until the calling line has been extended to the allotted bridge through a primary and a secondary line switch and until the allotter finder switch has connected its associated register sender to the mentioned bridge. The first of these operations is indicated by the energization of relay 36, while the completion of the finder operation is indicated by the energization of relay 58, and when both of these operations are completed the actuation of relay 48 is effected. Relay 48 effects the release of relay 45 to complete the operating circuit of the motor magnet 63. The finder allotter must not be operated until relay 45 deenergizes, otherwise if this allotter is advanced when relay 48 is operated, the next finder will be falsely started from ground at a contact of relay 45.

As soon as the relay 62 is operated, it completes an actuating circuit for slow releasing relay 65, extending from grounded battery, winding of this relay, lower armature and front contact of relay 62, conductor 66, and through a multiple conductor 67 to ground at the left hand back contact and armature of a relay similar to 65 at an idle bridge circuit. However, if all the bridge circuits are in use this last described circuit instead of being completed at the armature and back contact of some relay 65 will extend this circuit through the winding of relay 38 to ground. Relay 65 indicates that its associated bridge circuit is engaged and completes a circuit from ground, its left hand armature and front contact, brush 68 of the bridge allotter, outer armature and back contact of relay 38, back contact armature and winding of the motor magnet 49 to grounded battery. Under the control of this circuit the bridge allotter advances its brushes 37, 59, 68 and 70 until an idle bridge circuit is located at which time the operating circuit of the motor magnet is no longer completed. In the event that the relay 38 is operated due to the fact that all the bridge circuits are in use, the operating circuit of the motor magnet will be interrupted at the outer back contact and armature of relay 38 to prevent a needless operation of the bridge allotter. Also when relay 36 attracts its armatures it closes a circuit from ground, upper armature and front contact of relay 36, conductor 71, winding of slow releasing relay 72, resistance to grounded battery.

As soon as the relay 62 is operated it disconnects the upper winding of the relay 42 from its connection to grounded battery at the bridge circuit and extends the impulse circuit to the register sender. This circuit may be traced from grounded battery, winding of the motor magnet 75 its back contact and armature, contacts 76 of the off-normal switch, back contact and continuity spring of change over relay 77, tens register brush 78 in its normal position, inner back contact, continuity springs and winding of impulse relay 79, finder brush 56, conductor 80, upper armature and continuity spring of relay 62, through conductor 41 and the two sides in series of the selected primary trunk circuit and of the calling line, through the conductor 40 and lower winding of relay 42 to ground. Under the control of this circuit the impulse relay 79 is energized and at its outer front contact closes a circuit for motor magnet 75 to advance the tens register into position 2. Relay 79 also closes a locking circuit for itself which extends through continuity spring and armature of relay 79, secondary winding of the induction coil to grounded battery. The primary winding of this induction coil is connected to a source of tone current and this tone is transmitted to the calling subscriber's station indicating

to him that the apparatus is in condition to receive the impulses corresponding to the wanted line.

Let it be assumed that the designation of the wanted station is #32 under which assumption the subscriber at A first operates his impulse transmitter to effect three interruptions of the impulse circuit corresponding to the tens digit of this number. In response to the first of these interruptions the locking circuit for the impulse relay 79 is opened and it deenergizes to close an operating circuit for the motor magnet 75 extending from grounded battery, winding of this motor magnet, its back contact and armature, through the contact 76 of the off-normal switch, register brush 78 in its first position, outer back contact and armature of the impulse relay 70 to ground. The change-over relay 77 is also energized in a circuit in multiple of that just described and attracts its armatures. At its left hand armature and continuity spring it closes a break point in the operating circuit of the motor magnet 75 so that this circuit is now independent of the control of the off-normal contact 76. At the inner right hand armature and front contact of relay 77, the operating circuit of the motor magnet of the units register is interrupted to prevent its operation during the transmission of the tens series of impulses, while at the outer right hand armature and front contact of relay 77, a circuit is closed from ground through conductor 82, finder brush 83, conductor 84, inner front contact and armature of relay 62, winding of the relay 85 to grounded battery. Relay 85 attracts its armatures and at its contact 86 closes a substitute holding circuit for the relay 36, while at contact 87 of this relay the impulse circuit is extended to ground independent of the lower winding of the relay 42.

As soon as the register brush 78 reaches position two and the line circuit is closed by the dial, the impulse circuit is again completed through the winding of the impulse relay 79, this relay energizes and locks itself operated through its armature and continuity spring. At the outer armature and front contact of this relay a circuit is closed from ground, register brush 78 in its second position, continuity spring and armature of relay 77, and winding of the motor magnet 77 to grounded battery which advances the register into its third position.

In response to the second interruption of this tens series, the impulse relay 79 retracts its armatures and through its outer armature and back contact, and register brush 78 in its third position, it completes an operating circuit for the motor magnet 75 which advances the tens register brushes into their fourth position. In this position, the impulse relay 79 is again actuated and closes the mentioned locking circuit through its continuity spring and armature. At the outer armature and front contact of this relay an operating circuit is again complete for the motor magnet 75 which advances this register into its fifth position. In response to the third and last interruption of the tens series, the impulse relay 79 retracts its armatures and completes an operating circuit, for the motor magnet to advance the tens register into its sixth position. Here again the impulse relay is actuated and advances the tens register into its seventh position. At the close of this series of impulses the change-over relay 77 has its operating circuit interrupted for a relatively long interval so that it deenergizes and at its left hand armature and continuity spring opens the mentioned operating circuit of the motor magnet associated with the tens register and at its right hand armature and back contact it closes a break point in the operating circuit of the motor magnet 88 of the units register.

As soon as the relay 77 deenergizes after the impulse relay 79 is operated, an actuating circuit is closed for the motor magnet 88 of the units register, from grounded battery, winding of this magnet, its back contact and armature, contacts 89 of the off-normal switch, back contact and continuity spring of the change-over relay 90, inner armature and back contact of relay 77, contacts 91 of the off-normal switch now closed, units register brush 92 in its normal position, outer front contact and armature of impulse relay 77 to ground. Under the control of this circuit, the motor magnet 88 advances the units register into its first position in which it is in condition to receive the impulses corresponding to the units digit of the wanted number which are two in number. In response to the first interruption of the impulse circuit the impulse relay 79 has its locking circuit opened and it deenergizes to close an operating circuit for the motor magnet 88 through its outer back contact and armature and units register brush 92 in its first position. Under the control of this circuit, the units register advances into position two where the operating circuit of the impulse relay 79 is again closed. This relay closes its locking circuit and through its outer front contact and armature completes an operating circuit to advance the units register into its third position. In response to the next interruption, the impulse relay deenergizes and advances the units register in position four, and when the impulse relay is again operated it advances the units register into its fifth position. Here the impulse relay 79 energizes and remains operated for a relatively long interval which opens the operating circuit of the units

change-over relay 90 causing this relay to deenergize and thereby open the operating circuit for motor magnet 88.

If no other register sender is testing a called line, the test of line No. 32 is now effected in the following manner:—When relay 90 deenergizes a circuit is closed from grounded battery winding of relay 93, units register brush 94 in its fifth position, outer back contact and armature of relay 90, winding of relay 95, its continuity spring and back contact, inner back contact and continuity springs of relays 97 and 96 in series to ground at the back contact and continuity spring of relay 95. Relays 93 and 95 are operated in this circuit and close breakpoints in the test circuit of the wanted line. The relay 95 on actuation opens the operating circuit to the other similar relays such as 96 and 97 at their finder switches which will prevent the simultaneous testing of other lines. At the right hand armature and back contact of relay 95 the energizing circuit of relay 98 is opened but since it is slow releasing it will hold its armatures attracted for a relatively short period thereafter.

If the called line is idle, the test circuit will then be complete from ground at the middle armature and front contact of relay 58, right hand armature and front contact of relay 95, armature and front contact of relay 98, winding of relay 99, tens register brush 100 in its seventh position, contact 101 of relay 93, conductor 102 which extends through the uppermost armature and back contact of the cut off relay 17 of Figure 1 through the winding of the line relay 5 to grounded battery. In the event that the brushes of the primary line switch were not in engagement with terminals of idle primary trunk circuits, the line relay 5 will complete an operating circuit for the motor magnet 7 to advance the brushes of the primary switch to idle primary trunks. This operation of the primary line switch is the same as when one of this pair of telephone lines originates a call, and when the primary switch reaches an idle pair of trunks the cut-off relays such as 6 and 17 are operated to seize this pair of trunks thereupon the test conductor 102 is extended to the line switch brush 12 as will presently be described. Under the condition assumed, the brushes of the primary line switch are already in engagement with an idle primary trunk circuit and the cut off relay 17 is already operated to extend conductor 102 through the brush 12 of the primary switch, the uppermost armature and back contact of relay 103, upper winding of relay 21 to grounded battery. Relay 21 is operated in this circuit and at its upper armature and front contact closes a multiple energizing circuit for the relay 23. This relay when energized effects the operation of the motor magnet 104 of the secondary line switch appearing at the lower part of Figure 1 and it advances the line switch brushes 105 to 109 inclusive, until the test brush 109 encounters the test terminal of the allotted trunk to which the calling line has been extended. When this trunk circuit is reached the relay 103 is operated in a circuit completed from grounded battery, resistance, back contact and armature of motor magnet 104, lower winding, front contact and armature of relay 23, lower winding of relay 103, lower armature and front contact of relay 21, test brush 109 in engagement with test conductor 110, allotter brush 55, front contact and armature of relay 99 to ground. Relay 103 is thus energized and at its lower back contact and armature, opens the operating circuit for the motor magnet 104, while at its lower front contacts and armatures it extends the called lines to conductors of the allotted bridge circuit. At the uppermost armature and back contact of relay 103 the test circuit including conductor 102 is interrupted which causes the deenergization of the relay 99 of the finder switch which has previously been locked operated but the relay 103 has a holding circuit closed from grounded battery, upper winding and upper armature and front contact of relay 103, holding brush 107, holding conductor 111, winding of ringing relay 60 to ground at the lower front contact and armature of relay 72.

The ringing relay 60 is actuated and closes a signaling circuit from the source of ringing current through the lower winding of relay 112, right hand front contact and armature of relay 60, conductor 113 of the bridge circuit and through the primary and secondary brushes 105 and 14 through the bell at the called station and through the brushes 15 and 106 of the primary and secondary line switches to conductor 114 of the selected bridge circuit to resistance through the front contact and armature of relay 60, lower front contact and armature of relay 72 to ground. Ringing current is intermittently applied over this circuit in the well known manner until the called party responds at which time the trip relay 112 is actuated to short circuit the ringing relay 60 causing it to deenergize. The trip relay is then locked operated from ground applied through its upper winding, front contact and armature, inner back contact and armature off relay 60, lower front contact and armature of relay 72 to ground.

When the ringing relay 60 attracts its armatures it opens the locking circuit for the relay 58, causing this relay to deenergize. Relay 58 controls the release of the register sender and at its middle armature and back

contact closes a circuit from ground, off normal contacts 115 of the off-normal switch, armature, back contact and winding of the motor magnet 75 to grounded battery. This circuit causes the restoration of the tens register to normal. At the outer armature and back contact of relay 58 a restoring circuit for the units register is closed through off-normal contacts 116. It will be remembered that the relay 52 is energized in series with relay 58 so that relay 52 also deenergizes to render the finder under consideration accessible for use in a succeeding call. Talking battery is supplied to the calling line through the windings of relay 42 while talking battery is supplied to the called line through the windings of relay 119.

In the event that there are no bridge circuits available, relay 38 is operated and if no finder switch and its associated register sender is available relay 39 will be operated so that ground potential is applied over conductor 117 to cause the calling line to select the overflow trunk shown at the extreme right of Figure 1. When this trunk is seized, relay 118 is operated to apply a busy tone to the calling line. This tone is applied through the lower winding of relay 118 as long as the calling subscriber holds his connection, while relays 38 and 39 are energized.

Let it be assumed that the called line was busy when the mentioned test was made, under this assumption the conductor 102 will be open at the uppermost back contact and armature of relay 103 so that relay 99 of Figure 2 will not be operated. The test relay 61 will therefore be operated over a circuit traceable from grounded battery, winding of this relay its continuity spring and back contact, finder brush 57 back contact and armature of relay 99, back contact and armature of relay 98, right hand front contact and armature of relay 95, middle front contact and armature of relay 58 to ground. Relay 61 is thus actuated and closes a locking circuit for itself through its continuity spring and armature to ground at the upper front contact and armature of relay 36. A source of busy tone current is thus applied through the lowermost armature and front contact of relay 61 to the calling station.

At the termination of the connection when the calling party replaces his receiver on its switch hook, relay 42 deenergizes and shortly afterwards the holding relay 36 retracts its armatures. This removes ground from the holding conductor 43 to permit the deenergization of the relays 19 and 24. The deenergization of relay 19 effects the release of the cut off relay 6 and since the primary and secondary switches are of the type which remain in engagement with the trunk lines last used, this is all that is necessary to release them.

When the called party restores his receiver to its switch hook the relay 119 is deenergized and at its front contact opens the holding circuit of slow releasing relay 72 in the event that the calling party has already released. If, however, the calling party still maintains the connection when the slow releasing relay 72 deenergizes the trip relay 112 releases and opens the holding conductor 111. This permits relays 21 and 103 to release and the deenergization of relay 21 causes the release of relay 17. The release of this last mentioned relay places the secondary and primary line switches in condition for use on a succeeding call.

In the connection just described, it so happened that the calling and called lines both terminated at the same primary line switch. However, in the event that line A terminated in a different line switch from the called line its associated line will be extended to idle secondary line switches and if this associated line is not calling a selected secondary line switch will remain inactive. If the associated calling line originates a call during the period that line A is calling the secondary line switch to which the associated line is connected will be operated in the same manner as the secondary line switch already described. Likewise the line associated with the called line B will be connected to an idle secondary line switch which switch will remain inactive if the associated line is not calling or being called and will operate to seize the bridge circuit in case this line is calling or being called.

What is claimed is:—

1. In an automatic telephone system, an incoming circuit, a relay responsive to impulses transmitted over said incoming circuit, said relay being provided with normally open and normally closed contacts, progressively movable switches, magnets for advancing the same, and operating circuits for said magnets completed alternately at said normally open and said normally closed contacts.

2. In an automatic telephone system, register switches, each having a progressively movable brush and a motor magnet including a winding, a pair of conductors leading to said register switches, and operating circuits for each register switch including its brush, a motor magnet winding, and said conductors.

3. In an automatic telephone system, register switches, a magnet for each switch for advancing the same, an impulse relay having normally closed and normally open sets of contacts, means for causing a series of operations of said impulse relay, and operating circuits for said magnets closed through said contacts in response to the operations of said relay.

4. In an automatic telephone system, reg-

ister switches, a magnet for each switch for advancing the same, an impulse relay having normally closed and normally open contacts, said relay being responsive to impulses from a distant point, and operating circuits for said magnets completed alternately through said contacts in response to impulses transmitted to said impulse relay.

5. In an automatic telephone system, number storing devices each including a progressively movable automatic switch, an impulse relay controlled from a distant point for variably governing the operation of said automatic switches, a circuit for said impulse relay completed through contacts of said automatic switches, and a locking circuit for said relay.

6. In an automatic telephone system, a pair of register switches, circuits each having multiple branches terminating in each register switch, a motor magnet for each register switch, and an operating circuit for each motor magnet completed through the multiple contacts of its associated switch.

7. In an automatic telephone system, a register sender including register switches, a plurality of multi-contact relays connected to one of said register switches, a plurality of contacts of said relays connected to another register switch, controlling circuits having multiple branches terminating in each register switch, and means for directively advancing said register switches including said circuits.

8. In an automatic telephone system, a plurality of telephone lines, a plurality of bridge circuits, means for allotting bridge circuits for use, means including non-numerical switches for extending a calling telephone line to an allotted bridge circuit, a plurality of register senders each including a plurality of progressively movable switches, means for allotting senders for use, means for connecting an allotted sender with the bridge circuit to which the calling line is extended, an impulse relay for each register sender for successively controlling the progressively movable switches thereof, operating circuits for said impulse relay including the calling telephone line, an allotted bridge circuit and said progressively movable switches, a locking circuit for said impulse relay completed on energization of said relay, an impulse sender associated with the calling line for interrupting the locking circuit of said impulse relay and thereby controlling the advance of said progressively movable switches, and means including said operated register sender for causing the called line to be extended to the allotted bridge circuit.

9. In an automatic telephone system, pairs of telephone lines, automatic switches each having fixed and movable contacts, each pair of telephone lines terminating in the movable contacts of an automatic switch, trunk circuits terminating in said fixed contacts and means for interconnecting a calling telephone line and a wanted telephone line through a trunk circuit and the movable contacts of the respective lines.

10. In an automatic telephone system, pairs of telephone lines, primary and secondary switches each having fixed contacts and movable contacts co-operating therewith, a pair of said telephone lines terminating in the movable contacts of each primary switch, trunk circuits each terminating at one end in said primary switches and at its other end in the movable contacts of a secondary switch, bridge circuits terminating in two sets of fixed contacts in each of said secondary switches, and means for interconnecting calling and called telephone lines including trunk circuits, bridge circuits and said switches.

11. In an automatic telephone system, pairs of telephone lines, automatic switches each having fixed and movable contacts, said movable contacts being arranged for rotary movement to successively engage said fixed contacts, each pair of telephone lines terminating in movable contacts of an automatic switch, trunk circuits terminating in said fixed contacts, and means for interconnecting a calling telephone line and a wanted telephone line through a trunk circuit and the movable contacts of the automatic switches of the respective telephone lines.

12. In an automatic telephone system, pairs of telephone lines, automatic switches each having fixed and movable contacts, said automatic switches being of the type in which the movable contacts remain in engagement with the fixed contacts last used, each pair of telephone lines terminating in the movable contacts of an automatic switch, trunk circuits terminating in said fixed contacts, and means for interconnecting a calling telephone line, and a wanted telephone line through a trunk circuit and movable contacts of the automatic switches to the respective lines.

13. In an automatic telephone system, pairs of telephone lines, automatic switches, each having fixed and movable contacts, said movable contacts being arranged for rotary movement to engage said fixed contacts successively, each pair of telephone lines terminating in movable contacts of an automatic switch, trunk circuits terminating in said fixed contacts, and a starting circuit controlled over the calling telephone line for completing the connection between a calling telephone line and a wanted telephone line through a trunk circuit and the movable contacts of the automatic switches of the last mentioned telephone lines.

14. In an automatic telephone system, pairs of telephone lines, primary and secondary automatic switches, each having fixed and movable contacts, said movable contacts being arranged for rotary movement to engage said fixed contacts successively, each pair of telephone lines terminating in movable contacts of a primary automatic switch, trunk circuits extending between said primary and secondary switches, link circuits, a register sender common to said telephone lines, means responsive to the initiation of a call on one of said telephone lines for extending said telephone line through its primary automatic switch, a trunk circuit and a secondary automatic switch to a link circuit and to said register sender, said register sender being controllable over the calling telephone line to record the designation of a wanted telephone line, a starting circuit for the called telephone line for causing a primary and a secondary line switch to extend the called telephone line to the link circuit to which said calling telephone line has been connected, and means including said register sender for completing the starting circuit of the called telephone line.

In witness whereof, I hereunto subscribe my name this 26th day of May A. D. 1921.

WINFRED T. POWELL.