

June 2, 1925.

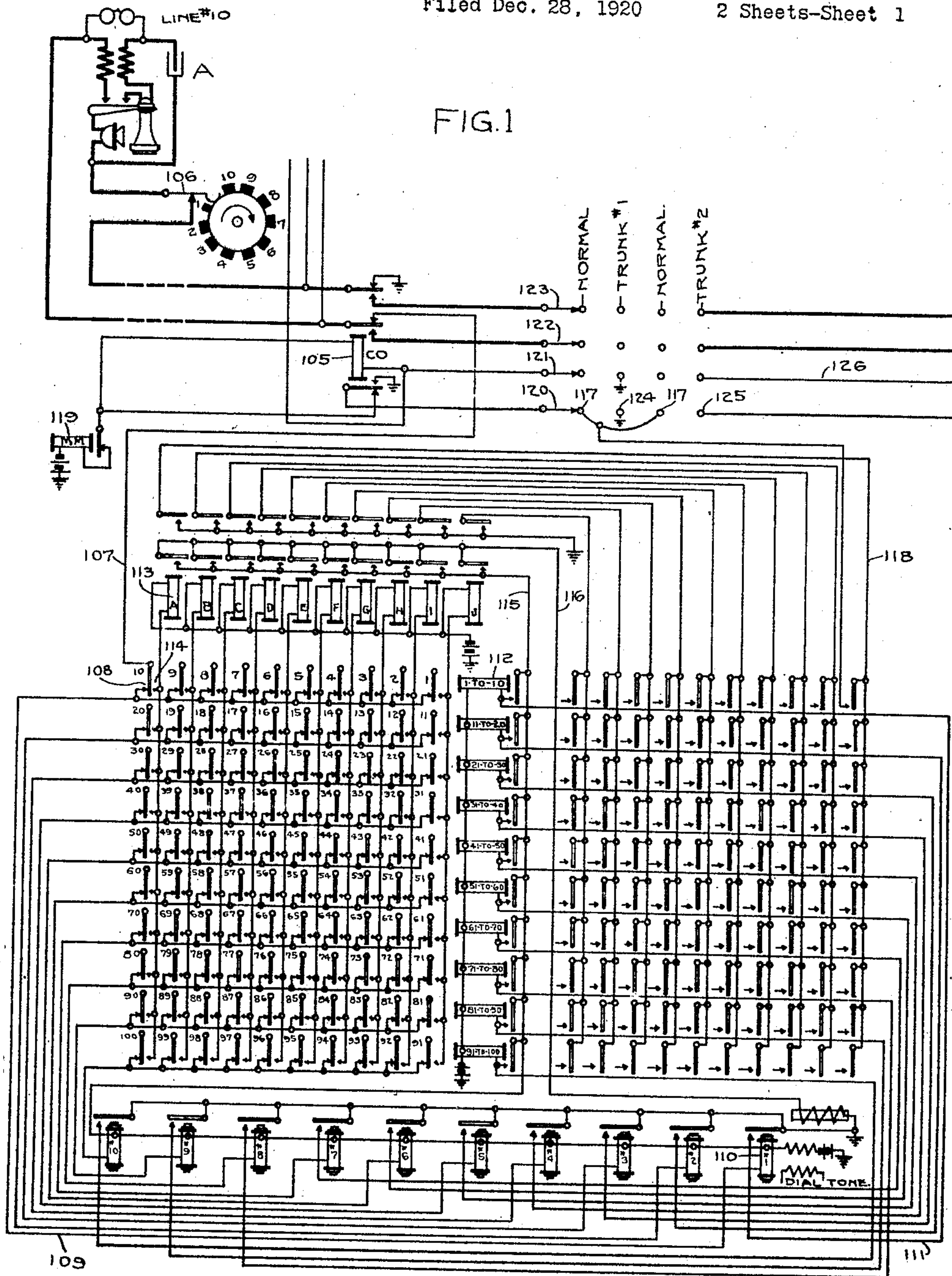
W. T. POWELL

1,540,419

AUTOMATIC TELEPHONE SYSTEM

Filed Dec. 28, 1920

2 Sheets-Sheet 1



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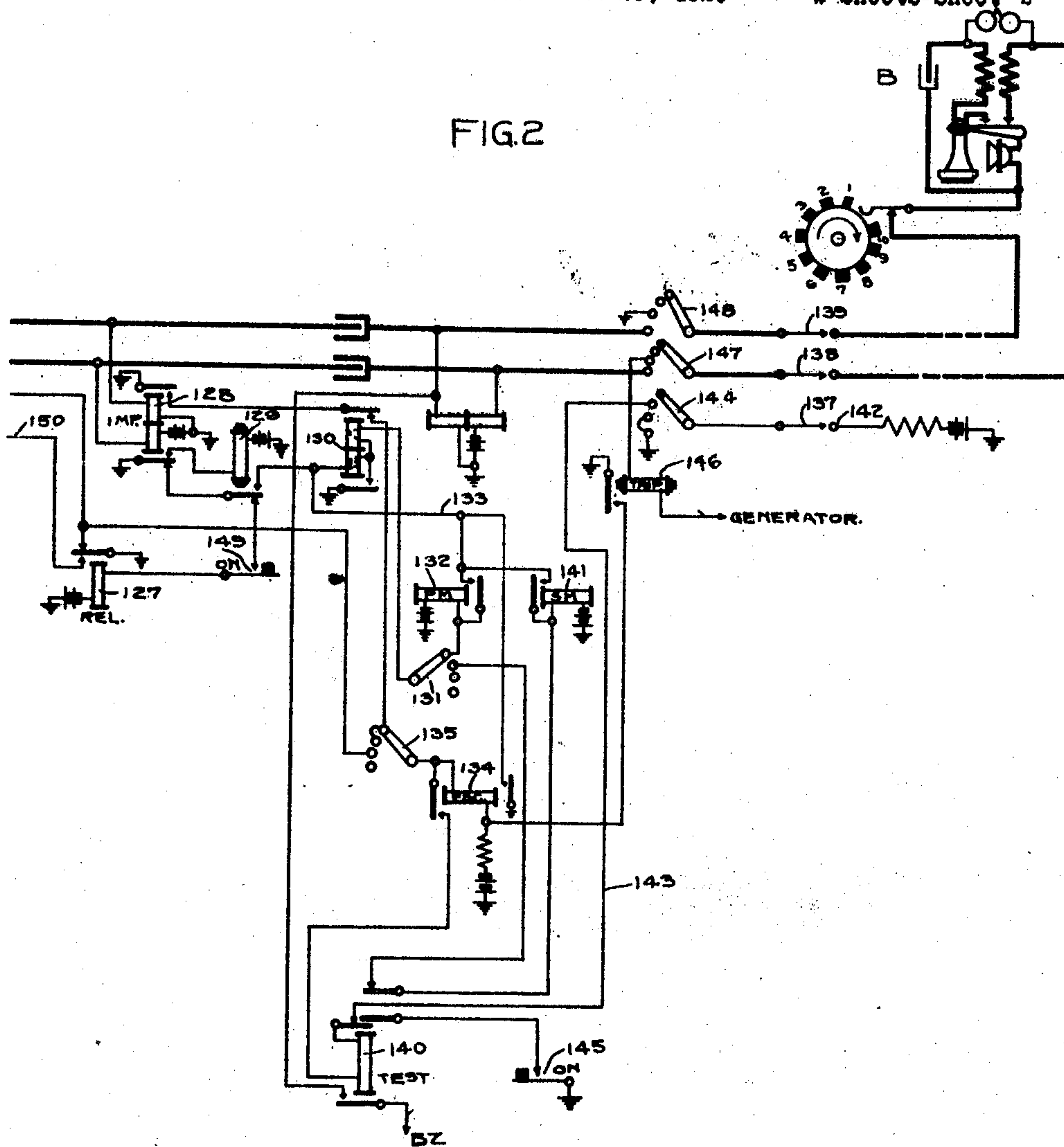
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2 Sheets-Sheet 2

FIG. 2



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Patented June 2, 1925.

1,540,419

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 December 28, 1920. Serial No. 433,677.

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.

This invention relates to telephone systems and more particularly to telephone systems employing automatic switches for establishing connections between calling and called telephone lines.

In former automatic telephone systems employing an individual trunk selecting switch provided with independent operating means, it was customary to provide a so-called line relay for each line. In accordance with the present invention it is proposed to arrange the telephone lines in groups and to provide a common group of relays, the total number of which relays is less than the number of lines, which group of relays performs the functions formerly performed by the line relay.

One feature of this invention therefore relates to novel means for controlling the individual trunk selector of a telephone line.

A second feature of this invention resides in improved means for directively operating numerical switches, while other features of the invention will appear from the detailed description and appended claims.

In the drawings Fig. 1 diagrammatically represents the sub-station circuits of one telephone line of a group as well as the operating circuits of the individual trunk selector switch of this line, while at the lower portion there are represented three groups of relays which co-operate in the control of a plurality of such line switches. In Fig. 2 there is represented the operating circuits of a connector switch as well as the sub-station circuits of a second telephone line herein referred to as the called or wanted line.

In accordance with one embodiment of this invention the lines of the telephone system are arranged in groups of 100 lines each and for the common use of each group of lines there are provided a group of relays arranged in three sub-groups for co-operating in the control of the motor mag-

nets of the line switches of the lines of the group.

The trunk selector switch may be of the type disclosed in the patent to Clement #1,107,153, August 11, 1914, although it will be understood that various forms of rotary switches may be employed in which each set of normal contacts is followed by one set of trunk contacts. The connector switch may be of the form disclosed in the patent to Keith, Erickson and Erickson #815,176, March 13, 1906, when modified to operate in a so-called two wire telephone system.

The small numerals refer to the numerical designation of the lines of the group and these numbers as well as the letters associated with certain of said relays together with the code at the lower part of Fig. 1, indicate which relays are related to the various lines.

Each sub-station is provided with a dial sender of any preferred form which interrupts the line circuit a number of times in accordance with the desired setting of the dial sender. The interruptions or impulses of each series are of equal duration, except the last which is much shorter than the others of the series.

With this brief description of the apparatus employed it is believed that the invention will best be understood by describing the method of establishing a telephone connection from a calling telephone line, indicated at A, to a called station indicated at B. When the subscriber at A removes his receiver from its switch hook, a circuit is closed from ground, at the uppermost armature and back contact of the cut-off relay 105, over the upper side of the calling line, impulse springs 106, through the sub-station circuits, over the lower side of the calling line in series, inner upper armature and back contact of the cut-off relay, conductor 107, contacts 108 of relay 112, conductor 109, winding of relay 110, secondary winding of the induction coil, to grounded battery. The primary winding of this last mentioned induction coil is connected to a source of dial tone current so that a tone is transmitted to the receiver of the calling subscriber until the circuits are in condition to receive the first series of impulses from the subscriber's dial sender.

The relay 110 is energized in the last described circuit and completes an operating circuit from ground, its upper armature and front contact, conductor 111, winding of relay 112, to grounded battery. Relay 112 closes the series of contacts shown at its right and left-hand and thereby opens the contacts 108 to sever the operating circuit of the relay 110, but this relay because of its slow releasing characteristics maintains the operating circuit for relay 112 for an appreciable interval. As soon as the relay 112 attracts its armatures, a circuit is closed from grounded battery, winding of the relay 113, contacts 114, conductor 107, over the two sides of the calling line in series to ground at the uppermost armature and back contact of relay 105. The relay 113 is thus operated to complete a locking circuit for the relay 112 from grounded battery, winding of this relay, its innermost right-hand front contact and armature, conductor 115, inner front contact and armature of relay 113, conductor 116, winding of the impedance coil, to ground. With relays 113 and 112 operated ground potential is applied to the normal contacts 117 from ground, uppermost front contact and armature of relay 113, conductor 118, to the contacts 117. This condition is effective to initiate the operation of the motor magnet 119 of the line switch which is actuated in a circuit traceable from grounded battery, winding of this magnet, its back contact and armature, lower back contact and armature of the cut-off relay, brush 120, terminal 117, to ground, as previously described. Under the control of this circuit the motor magnet 119 advances its brushes 120, 121, 122 and 123 into engagement with the terminals of trunk #1.

Let it be assumed that this trunk is busy, under which assumption its test terminal 124 would be characterized by ground potential and a circuit will thereby be completed for operating the motor magnet 119 to advance the brushes of the line switch into engagement with a second set of home contacts 117 also characterized by ground potential so that the motor magnet will advance the brushes of the line switch into engagement with the terminals of a second trunk which is shown in full in these drawings.

Let it be assumed that this trunk is idle, a condition which is indicated by the absence of potential on its test terminal 125. The cut-off relay 105 will then be operated in a circuit completed from grounded battery, winding of the motor magnet and winding of the cut-off relay in series therewith, holding brush 121, conductor 126, back contact and armature of the release magnet 127, to ground. The cut-off relay is energized in this circuit and, at its upper arma-

tures and back contacts, it opens the circuits by which the group of relays was initially energized, while at the front contacts of these armatures the calling line is extended to the line brushes 122 and 123. At the lowermost armature and front contact of cut-off relay, ground potential is applied to test brush 120 and through its brush to the test terminal 125 of the selected trunk to render it non-selectable. It will also be understood that when the operating circuits of the groups of relays are open that the dial tone is disconnected from the calling line which indicates to the subscriber thereon that his line is connected to an idle numerical switch and that he may then operate his dial sender.

When the calling line was connected to the line switch brushes 122 and 123 by the operation of the cut-off relay upon the seizure of a selected trunk, the impulse relay 128 was energized in a circuit including both sides of the selected trunk and the calling line in series. Relay 128 is energized in this circuit and at its lower armature and front contact completes a circuit for the slow releasing relay 129 which controls the release of the connector switch, as will be described. The calling subscriber now operates his dial sender intermittently opening and closing the contacts 106 to transmit a series of impulses corresponding to the tens digit of the wanted number. In response to this series of impulses the impulse relay 128 vibrates its armatures and on its first deenergization at its lower armature and back contact it closes a circuit from ground, through the lower armature and front contact of relay 129, through the high resistance and low resistance windings of the change-over relay 130 in series, side switch wiper 131, winding of the primary magnet 132, to grounded battery. Since it is assumed that this first impulse is relatively long, the change-over relay 130 will be energized in this circuit but the primary motor magnet will not operate in series with the high resistance winding of the change-over relay. The change-over relay 130 on energization short-circuits its high resistance winding by completing a circuit from ground, its lower armature and front contact, its upper low resistance winding, side switch wiper 131, winding of the primary magnet 132, to grounded battery. This last named magnet will now operate in series with the low resistance winding of relay 130 and closes its armature and front contact. Before the impulse relay 128 is again attracted at the close of the impulse just mentioned and with the armature and contact of the primary motor magnet 132 closed, both windings of the change-over relay 130 are short-circuited by a circuit including conductor 133, front contact and armature of

relay 129, back contact and armature of
 relay 128, to ground. Relay 130 therefore
 retracts its armatures. Shortly after this
 the impulse relay is operated and causes the
 5 primary motor magnet to release and ad-
 vance the brushes 137, 138 and 139 one step
 in the group selecting movement. This op-
 eration of relays 128 and 130 and magnet
 132 is repeated for each impulse until the
 10 last impulse of the series is transmitted.
 This impulse is of short duration, as com-
 pared with those preceding it, so that the
 operation will now be as follows. The im-
 pulse relay 128 retracts its armatures and
 15 closes a circuit from ground, through its
 lower armature and back contact, armature
 and front contact of relay 129, both wind-
 ings in series of relay 130, side switch wiper
 131 in its first position, winding of the pri-
 20 mary motor magnet 132, to grounded bat-
 tery. Relay 130 attracts its armatures and
 at its lower armature short-circuits its high
 resistance winding and closes a circuit for
 energizing primary motor magnet 132.
 25 However, before the primary motor magnet
 132 operates, the impulse relay 128 attracts
 its armatures and the previously described
 short-circuit including conductor 133 is not
 completed, so that when the primary motor
 30 magnet 132 does operate it is locked ener-
 gized through the side switch wiper 131 and
 the low resistance winding of relay 130 to
 ground at its lower armature and front con-
 tact. The escape magnet 134 is now ener-
 35 gized over a circuit extending from ground-
 ed battery, resistance, winding of this mag-
 net, side switch wiper 135 in its first posi-
 tion, upper armatures and front contacts of
 relays 130 and 128, to ground. This mag-
 40 net attracts its armatures and at its right-
 hand armature closes a short-circuit about
 relay 130 which deenergizes and opens the
 circuit of the escape magnet thereby causing
 the side switch wipers to be moved into
 45 their second position. When the escape
 magnet releases the primary motor magnet
 is deenergized.

The subscriber now operates his dial
 switch to transmit impulses corresponding
 50 to the units digit of the wanted number.
 In response to the first of these impulses
 the impulse relay 128 retracts its armatures
 and the change-over relay 130 is now oper-
 ated in a circuit closed from ground, lower
 55 armature and back contact of impulse relay
 128, armature and front contact of relay
 129, through both windings in series of
 relay 130, side switch wiper 131 in its second
 position, uppermost back contact and arma-
 60 ture of test relay 140, winding of the second-
 ary motor magnet 141, to grounded battery
 and, as described in a previous instance,
 relay 130 is locked operated in series with
 the secondary motor magnet and short-cir-
 65 cuits the high resistance of that relay. The

secondary motor magnet 141 is thereupon
 locked operated in a circuit traceable from
 grounded battery, its winding, armature and
 front contact, conductor 133, front contact
 and armature of relay 129, back contact and
 70 armature of relay 128, to ground. When
 the impulse relay again attracts its arma-
 tures at the close of this impulse, secondary
 motor magnet 141 deenergizes and advances
 the connector brushes over the terminals of
 75 the selected group of lines. In response to
 the next impulse of the series, impulse relay
 128 retracts its armatures and again closes
 a circuit through both windings of relay 130
 and magnet 141 in series. Magnet 141 does
 80 not operate, but relay 130 does operate and
 short-circuits its high resistance winding to
 effect the operation of the motor magnet.
 This operation is continued until the last
 or short impulse of the series is received,
 85 at the close of which the impulse relay will
 attract its armatures before relay 130 is re-
 leased and the escape magnet is operated in
 a circuit from grounded battery, resistance,
 winding of this magnet, side switch wiper
 90 135 in its second position, front contacts and
 armatures of relays 130 and 128, to ground.
 This magnet attracts its armatures and at its
 right-hand armature closes a short-circuit
 about relay 130, which releases to open the
 95 original energizing circuit of the escape
 magnet.

Let it be assumed that the called line is
 busy which condition is indicated by ground
 100 potential on the test terminal 142 of this
 line, so that the escape magnet will then
 be locked operated in a circuit closed from
 grounded battery, resistance, its winding,
 armature and front contact, winding of test
 relay 140, its continuity spring and contact,
 105 conductor 143, side switch wiper 144 in its
 second position, connector test brush 137,
 test terminal 142, and a multiple terminal
 thereof through a test brush similar to 137
 and a side switch wiper similar to 144 in
 110 its fourth position, to ground at the con-
 nector switch which has previously seized
 the wanted line. The test relay is operated
 in this circuit and then locked operated in
 a circuit from ground, through the off-nor-
 115 mal contacts 145, inner armature and con-
 tinuity spring and winding of test relay 140,
 over the remainder of the circuit previously
 described as extending through the winding
 of escape magnet 134. With the test relay
 120 140 operated, a source of busy tone current
 BZ is applied to the calling line through
 the lower armature and front contact of the
 test relay.

It will now be assumed that the wanted
 125 line is idle at the time when the test brush
 137 engaged the test terminal 142 of this
 line. Under this assumption the side switch
 wipers move into their third position where
 the escape magnet is now operated over a
 130

circuit from grounded battery, resistance, its winding, side switch wiper 135, in its third position, back contact and armature of release magnet 127, to ground. Also in
 5 this position, an interrupted source of signalling current, herein designated generator is applied to the called line, through the winding of the trip magnet 146, side switch
 10 wiper 147, connector brush 138, through the sub-station circuits and bell of the called line, over the upper side of the line, connector brush 139, side switch wiper 148 in
 15 its third position, to ground. The trip relay 146 is of the well known type which does not energize in series with the resistance of
 20 called bell but, when the called party responds, it does operate and closes a short-circuit from ground, at its armature and front contact about the escape magnet which
 25 causes this magnet to release and move the side switch wipers into their fourth or talking position.

At the termination of the call, the calling subscriber replaces his receiver on the switch
 25 hook and thereby effects the deenergization of the impulse relay 128 to open the circuit of relay 129 which shortly afterwards deenergizes and closes the circuit for the release magnet 127 from grounded battery,
 30 winding of this magnet, off-normal contacts 149, back contacts and armatures of relay 129 and the impulse relay 128, to ground. Relay 127 is energized to effect the release of the connector switch and restore its side
 35 switch wipers to normal position. The release magnet also attracts its armature to open the holding circuit including conductor 126 of the cut-off relay 105 and this relay deenergizes and retracts its armatures.
 40 Thereupon a circuit is closed from ground at the armature and front contact of magnet 127, conductor 150, brush 120, lower armature and back contact of relay 105, armature,
 45 back contact and winding of the motor magnet 119, to grounded battery. Under the control of this circuit, the motor magnet 119 advances the brushes of the line switch to the next one of its normal positions.

It will be understood that one or more
 50 selector switches may be interposed between the line switches and the connectors if the size of system requires such additions and other variations within the scope of the claims may be made without department
 55 from the spirit of the present invention.

What is claimed is:

1. In a telephone exchange system, a plurality of telephone lines divided into groups, a selecting switch for the use of each tele-
 60 phone line, independent operating means for each switch, a group of relays common to each one of said groups of lines and less in number than the number of said telephone lines for controlling the operating
 65 means of the selecting switch of the calling

line, and operating circuits for certain of said relays including said telephone lines.

2. In a telephone exchange system, a plurality of telephone lines arranged in groups, trunks for extending any of said lines in
 70 the direction of the called line, a trunk selecting switch for each telephone line operating to connect its line with an idle trunk, individual operating means for each
 75 trunk selecting switch, a plurality of relays individual to each group of lines arranged in subgroups, one subgroup of relays being common to certain of said lines and a second
 80 subgroup of relays being common to certain other lines, means for operating a relay in each subgroup on the initiation of a call, and means controlled jointly thereby for actuating the operating means of the indi-
 85 vidual trunk selecting switch of the calling line.

3. In a telephone exchange system, a plurality of telephone lines arranged in groups, a plurality of trunks for interconnecting
 90 said telephone lines, a trunk selecting switch for each line operating to select idle trunks, a group of line relays individual to each group of lines less in number than the number of said lines, said relays being arranged
 95 to be operated on the initiation of a call, and means controlled thereby for operating the trunk selecting switch of the calling line.

4. In a telephone exchange system, a plurality of telephone lines arranged in groups, a cut-off relay for each telephone line, a
 100 plurality of trunks and numerical switches for interconnecting said telephone lines, a trunk selecting switch for each line operating to select idle trunks, a group of line relays individual to each group of lines less
 105 in number than the number of said lines, said line relays being operated on the initiation of a call, means controlled thereby for operating the line switch of the calling line to seize an idle trunk, and means responsive
 110 to such seizure for operating the cut-off relay and effect the deenergization of the operated line relays.

5. In a telephone exchange system, a plurality of telephone lines arranged in groups, a plurality of trunks and numerical switches
 115 for interconnecting said telephone lines, a trunk selecting switch for the use of each line operating to select idle trunks, a line relay common to a plurality of lines in a group, a secondary line relay common to a
 120 second set of lines of a group, one of said telephone lines being common to both of the last mentioned groups of telephone lines, a third relay common to said first group of
 125 lines operating to disconnect said first relay and connect said second relay to the calling line, and means responsive to the operation of said relays for effecting the operation of the trunk selecting switch.

6. In a telephone system, a plurality of

telephone lines, arranged in groups, trunks and numerical switches for interconnecting said telephone lines, a trunk selecting switch for the use of each telephone line operating to select idle trunks on the initiation of a call, a line relay common to a plurality of the lines of a group, a second line relay common to a second set of lines of said group, one telephone line being common to both groups of relays, a third relay common to said first group of lines operating to disconnect said first relay and connect said second relay to said line on the initiation of a call, operating means for said trunk selecting switch responsive to said relays for causing said switch to seize an idle trunk, and a cut-off relay operated on the seizure of an idle trunk to disable said operated relays.

In witness whereof, I hereunto subscribe my name this 27th day of December A. D. 1920.

WINFRED T. POWELL.