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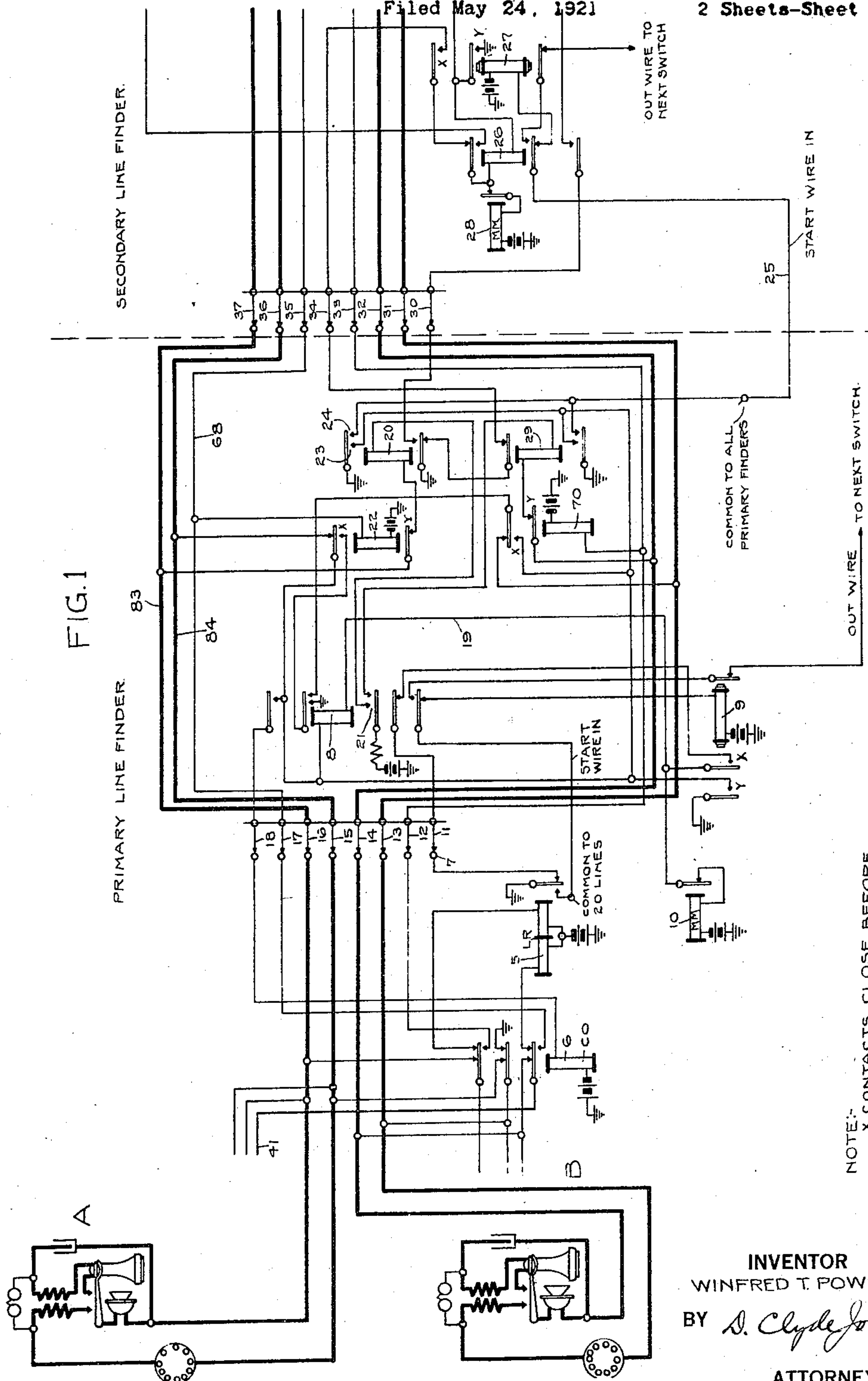
1,499,871

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed May 24, 1921

2 Sheets-Sheet 1



INVENTOR
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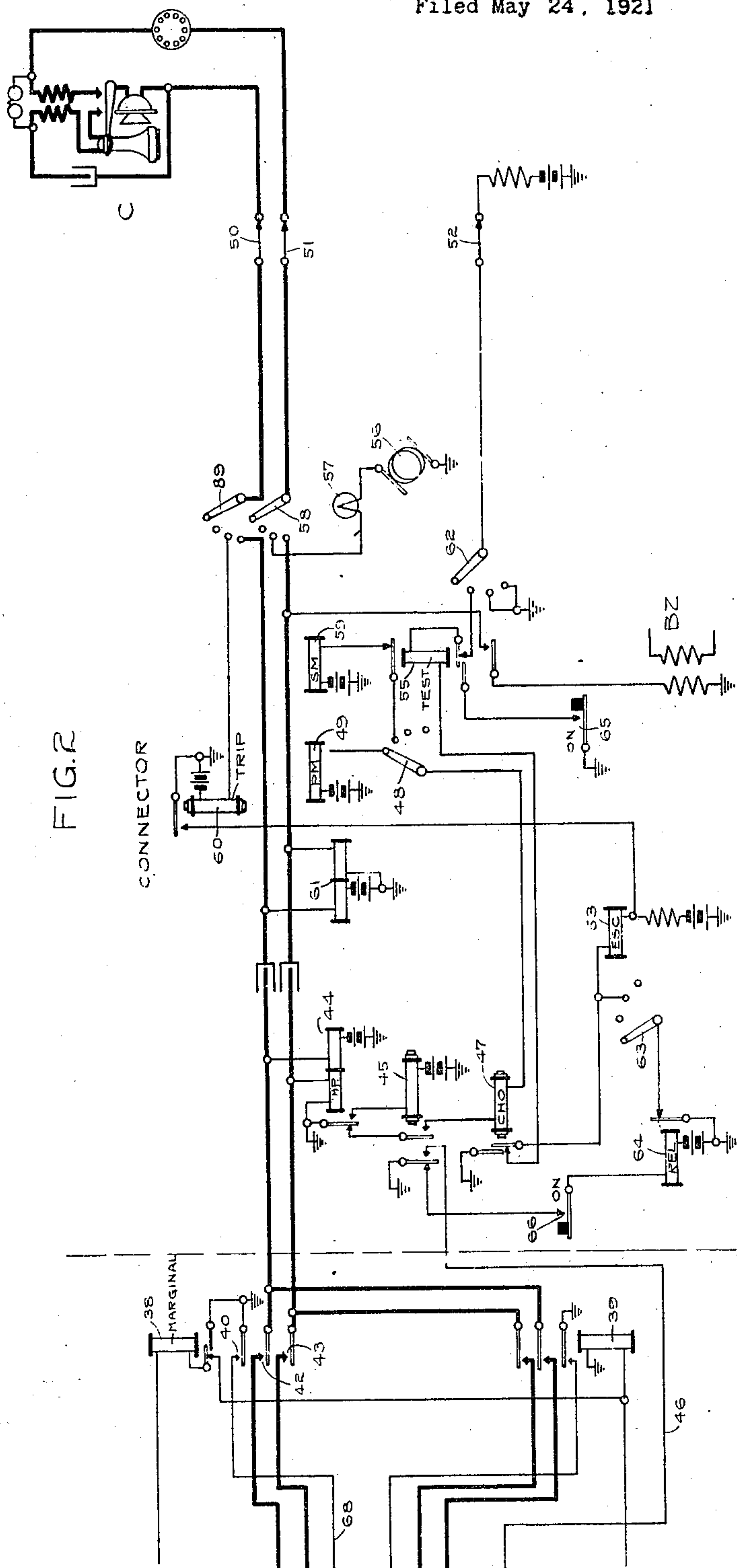
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2 Sheets-Sheet 2



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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 24, 1921. Serial No. 472,088.

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 in establishing telephone connections.

In former telephone systems where primary line finding switches have been used it is possible for the primary line finder switch to connect only one telephone line to an idle trunk. In accordance with the present invention it is proposed to simultaneously extend two or more telephone lines to idle trunks through a single line finder switch.

It is further proposed to use a single line relay and a single cut off relay for the use of a pair of telephone lines.

Other features of the invention will appear from the detailed description and appended claims.

The drawings with Fig. 2 placed at the right of Fig. 1 diagrammatically represent so much of a telephone system as is necessary for a clear understanding of the present invention. At the left of Fig. 1 there are represented two subscriber substations and telephone lines connecting these substations with the main exchange. At the left of the dotted line of this figure, there appears the controlling circuits and the brushes of a primary line finder switch. At the right hand of this dotted line and at the left of the dotted line of Fig. 2 there is represented the controlling circuits of a secondary finder switch. At the right of the dotted line of Fig. 2 there is represented a connector switch and a called substation.

The line finder switch of this disclosure may be of any well known type of unidirectional switch, such as that disclosed in the patent to Clement. 1,107,153 patented August 11, 1914. The numerical switches of this disclosure may be similar to that disclosed in the patent to Keith et al. #815,176 issued March 13, 1906.

In accordance with one arrangement of

the present system the subscribers' lines may be arranged in groups of twenty lines which terminate in the terminals of ten-point primary finder switches. Each such switch is provided with two sets of brushes which simultaneously engage the terminals of two lines and each group of lines and primary finder switches are provided with a pair of primary trunks which terminate in the terminals of a forty point secondary finder switch. In this arrangement one hundred lines will be arranged in groups of twenty lines and will have access to forty primary trunks terminating in the terminals of secondary finder switches. These secondary finders through their secondary trunks extend these one hundred lines to any one of a group of ten connector switches. An allotter in the form of an extended starter wire arrangement is provided for each group of primary finders and for each group of secondary finders to allot these switches for use. It will be understood that the grouping arrangement and the percentage of trunking may be widely varied in accordance with traffic requirements without departing from the spirit of 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 that represented at C. When the calling subscriber at A removes his receiver from its switch hook a circuit is closed for operating the line relay 5, extending from grounded battery, right hand winding of this relay, uppermost armature and back contacts of the cut off relay 6, over the upper side of the calling line through the substation circuits in series and over the lower side of the calling line, back contacts and middle armature of the cut off relay 6 to ground.

The line relay, when energized, attracts its armature and at its back contact removes ground potential from test terminal 7 indicating a stopping point for the primary line finder switch. At the front contact and armature of the line relay, a circuit is closed from ground, lowermost armature and back contact of relay 8, winding of slow releasing relay 9, to grounded battery. The relay 9 is a starting relay for the pri-

mary line finder switch herein shown and when it is thus operated it attracts its armatures and an operating circuit is thereby completed for the motor magnet 10 of the primary line finder switch. This circuit is traceable from grounded battery, winding, back contact and armature of the motor magnet 10, inner armature and front contact of relay 9, back contact and middle armature of relay 8, test brush 11 of the finder switch, test terminal such as 7 of non-calling lines, through the back contact and armature of line relays similar to 5 to ground. Under the control of similar circuits the motor magnet 10 advances its brushes 11 to 18 inclusive until the test brush 11 encounters the test terminal 7 of the calling line which is characterized by the absence of ground potential.

It will be noted that as soon as the starting relay 9 is operated, an energizing circuit for relay 8 is closed extending from grounded battery, winding back contact and armature of the motor magnet 10 conductor 19, winding of relay 8 outer front contact and armature of relay 9 to ground. The relay 8, however, is short circuited as long as the test brush 11 encounters test terminals having ground potential such as characterizes non-calling lines. When, however, the calling line is located the mentioned short circuit is removed and the relay 8 is operated in the circuit just described. As soon as the relay 8 is operated, it closes an actuating circuit for the cut off relay 6 completed from grounded battery, winding of this relay, finder brush 18, uppermost armature and front contact of relay 8, outer front contact and armature of relay 9 to ground. Relay 6 on operating disconnects line relay 5 from the control of either of its associated calling lines such as A and B. Line relay 5 then deenergizes and removes the calling condition from test terminal 7, likewise the incoming test terminals of the lines A and B are extended to the brushes 12 and 17; also when relay 8 is operated it closes an actuating circuit for the relay 20 extending from grounded battery, resistance, contact 21 and armature of relay 8, winding of relay 20, lower back contact and armature of relay 22, over the upper side 83 of the primary trunk circuit, finder brush 17 and both sides of the calling line and substation circuits in series, the lower side 84 of the primary trunk, upper back contact and armature of relay 22, to ground at the outermost front contact of relay 9.

With the relay 20 operated, a substitute energizing circuit for relay 8 is closed from grounded battery, winding, back contact and armature of the motor magnet 10, conductor 19, winding of relay 8, contact 23 and armature of relay 20 to ground; also at contact 24 and upper armature of relay 20 a circuit

is closed from ground over the starting conductor 25 lower back contact and armature of relay 26, winding of relay 27 to grounded battery. Relay 27 closes an operating circuit for the motor 28 of the allotted secondary line finder from grounded battery winding, armature and back contact of motor magnet 28, upper armature and back contact of relay 26, uppermost armature and front of relay 27, secondary finder brush 34, back contact and armature of relays similar to 29 and 20 to ground. Under the control of such circuits the motor magnet 28 advances the brushes 30 to 37 inclusive until the test brush 34 encounters the trunk circuit that has been extended to the calling line by the primary line finder switch: this trunk will be indicated by the absence of ground potential due to the energization of either relays 20 or 29. It will be understood that an operating circuit was closed for relay 26 as soon as the starting relay 27 had operated, its circuit being closed from grounded battery, winding of the motor magnet 28, its armature and back contact, winding of relay 26, inner armature and front contact of relay 27 to ground. Relay 26, however, is short circuited by ground potential applied through test brush 34 until the selected primary trunk is located at which time the mentioned short circuit is no longer completed and relay 26 is operated to interrupt the operating circuit of 27. With relay 26 operated, a circuit is closed for actuating marginal relay 38 extending from grounded battery, winding, armature and back contact of the motor magnet 28 upper armature and front contact of relay 26, winding of relay 38 its continuity spring and back contact, lowermost front contact and armature of relay 26, finder brush 30, front contact and armature of relay 20 to ground. The relay 38 when operated closes a locking circuit for itself through its inner armature and continuity spring to ground. The relay 38 is marginal so that it will not energize in series with relay 39 and it will be noted that relay 39 is short circuited by the mentioned operating circuit of relay 38 so that relays 38 and 39 will not be simultaneously operated thus assuring that only one subscriber's line will be extended to the trunk circuit terminating in the numerical switch of Fig. 2. At the contact 40 and armature of relay 38, ground potential is applied over finder brush 35 and primary finder brush 17, and through the innermost front contact and armature of relay 6 to apply a guarding potential to conductor 41 which is connected to test terminals of the calling line A at the various connectors through which it may be reached as a calling line. At contacts 42 and 43 of relay 38, the calling line is extended through both windings in series of the impulse relay 44 to

grounded battery. Impulse relay 44 is thereby energized and at its armature and front contact closes an operating circuit for the slow releasing relay 45. This relay at its outer armature and front contact closes the holding conductor 46 which maintains the holding relay 26 operated.

The apparatus is now in condition to receive the directive impulses from the impulse transmitter at the calling substation. For purposes of this description it has been assumed that the secondary trunk terminates in a connector switch but it will be understood that if it is desired to employ the present invention in a relatively large system numerical switches such as first and second selectors will be employed to extend the calling line to a connector switch through which the called line can be reached.

The calling subscriber at A thereupon operates his impulse transmitter a series of impulses corresponding to the tens digit of the wanted number. In response to each of these impulses the impulse relay 44 retracts its armature and closes a circuit from ground through the inner armature and front contact of relay 45, winding of the change-over relay 47, side switch wiper 48 in its first position, primary motor magnet 49 to grounded battery. Relay 47 is energized to cause the operation of the escape magnet and since relay 47 does not deenergize during a series of impulse, the escape magnet is held operated. Under the control of this magnet the motor magnet 49 advances its brushes 50, 51, and 52 in their primary movement to select a group of lines through which the called line may be reached. At the close of this series of impulses the impulse relay 44 holds its armature attracted for a relatively long period so that the slow releasing change-over relay 47 deenergizes and opens the operating circuit for the escape magnet 53, whereupon this magnet advances its wipers into their second position. The subscriber at A now dials the units series of impulses and the impulse relay 44 now vibrates its armature to close an operating circuit for the secondary motor magnet 59, from grounded battery, winding of this magnet, back contact and armature of relay 55, side switch wiper 48 in its second position, winding of the change-over relay 47, inner front contact and armature of relay 45, back contact and armature of relay 44 to ground. Relay 47 when actuated, closes an actuating circuit for the escape magnet 53, traceable from grounded battery, resistance, winding of this magnet, continuity spring and armature of change-over relay 47 to ground. Since the change-over relay 47 is slow-releasing, it holds the escape magnet 53 operated during the units series of impulses.

In response to each retraction of the armature of impulse relay 44, the described operating circuit of the secondary motor magnet 59 is completed and this magnet advances the brushes of the connector switch in their secondary direction to select the wanted line of the selected group. At the close of the units series of impulses, the impulse relay 44 will maintain its armature attracted so that the energizing circuit of relay 47 is opened for a long enough period to permit this relay to deenergize. This opens the operating circuit of the escape magnet 53 and in the event that test brush 52 of the connector finds the wanted line idle, escape magnet 53 deenergizes and moves the side switch wipers into their third position. Here the escape magnet 53 is maintained energized through side switch wiper 63, to ground at the back contact and armature of release magnet 64.

In this position ringing current is applied to the wanted line in a signalling circuit completed from ground, ringing generator 56, lamp 57, side switch wiper 58, connector brush 51, through the lower side of the wanted line and the signal of the wanted station over the upper side of the wanted line, connector brush 50, side switch wiper 89 in its third position, winding of the trip relay 60 to grounded battery. Ringing current is applied over this circuit until the called party responds at which time the relay 60 is operated and at its upper armature and contact short circuits the escape magnet 53 causing it to deenergize and advance its side switch wipers into their fourth or talking position.

The talking current is supplied to the calling party through the windings of impulse relay 44, while talking current is supplied to the called party through the windings of impedance coil 61.

In the event that the wanted line is busy when it is tested by the test brush 52 of the connector, as soon as the change-over relay 47 deenergizes, the escape magnet 53 will be maintained energized in a circuit closed from grounded battery, resistance, winding of this magnet, continuity spring and back contact of relay 47, winding of the test relay 55, its continuity spring and back contact, side wiper 62 in its second position, test brush 52 and test terminal of the called line and through the multiple test terminal and test brush similar to 52 at the connector that has already seized the called line through a side switch wiper similar to 62 associated with this connector switch in its fourth position to ground. Under the control of this circuit the escape magnet 53 is maintained operated and the test relay 55 is actuated to close an operating circuit for itself through its continuity spring and armature, off normal contacts 65 to ground.

With the escape magnet 53 held operated the side switch does not advance from its second position, so that the busy called party is not signalled. Also with the test relay 55 locked operated busy tone current B Z is applied through the lowermost armature and front contact of this relay to the calling line to inform the calling subscriber that the wanted line is busy.

When the calling subscriber at A terminates a call, he replaces his receiver on its switch hook. The impulse relay 44 deenergizes and thereby opens the operating circuit for the slow releasing holding relay 45. At the outer armature and back contact of this relay an operating circuit for the release magnet 64 is completed from grounded battery. Winding of this magnet off normal contacts 66, back contact and armature of relay 45 to ground. The release magnet 64 thereby releases the connector switch as well as its side switch wipers into their normal position. At the outer armature and front contact of relay 45 the holding conductor 46 is opened permitting the holding relay 26 to deenergize. This relay opens the circuit of marginal relay 38 to disconnect the impulse relay from the secondary finder brushes 36 and 37. At contact 40 and armature of relay 38 the holding conductor 68 which has been maintaining the holding relay 22 operated is interrupted and this relay retracts its armatures.

In the event that a subscriber at station B originates a call when the associated line from substation A is not calling, then the line relay 5 will energize the starting relay 9 which causes the motor magnet 10 to advance the brushes of the primary line finder switch to locate the calling line in the manner already described. When the calling line leading to substation B is located, relay 8 will be operated and this in turn will cause the operation of relay 29. Relay 29 when operated causes the actuation of starting relay 27 which causes the motor magnet 28 to advance the brushes of the secondary line finder switch to hunt for the primary trunk that has been connected to the calling line. When this primary trunk is located the operation of the motor magnet 28 will be stopped and relay 26 will be operated to effect the operation of the relay 39. Relay 39 on attracting its armatures extends the talking brushes 31 and 32 of the secondary line finder switch to the connector switch. This relay at its innermost armature and front contact also closes an operating circuit for relay 70 which serves as a holding relay for the primary line finder switch by reason of its completing a holding circuit for the relay 8. This circuit is traceable from grounded battery winding, back contact and armature of magnet 10 and conductor 19, winding of relay 8, uppermost front contact and armature of relay 70 upper front contacts and armature of relay 8 to ground. The release of this portion of the connection will take place in the manner already described.

Let it be assumed that the subscriber at substation B originates a call at the time when the subscriber at substation A is establishing or maintaining the connection. Under this assumption the cut off relay 6 and relay 8 will be operated. Therefore, when the subscriber at B removes his receiver from its switch hook an operating circuit is closed for the relay 29 from grounded battery, resistance, innermost lower armature and front contact of relay 8, winding of relay 29, inner back contact and armature of relay 70, through finder brush 14, over the upper side of the calling line and substation circuits in series, over the lower side of the calling line, finder brush 13, uppermost back contact and armature of relay 70, inner front contact and armature of relay 8 to ground. With relay 29 operated a secondary finder starting circuit is closed from ground at the lower armature and front contact of relay 29 over the conductor 25, but in this instance the starting circuit is extended through the inner armature and front contact of relay 26, lower armature and back contact of relay 27 to the out wire leading to the next idle secondary line finder. This finder switch will then operate in the same manner as the first described secondary line finder but in this case will extend the calling line from substation B to an idle connector switch (not shown).

If the subscriber at A disestablishes the connection before the subscriber at B desires to terminate his conversation this last mentioned connection will still be maintained, for the holding relay 8 will still be maintained operated in a holding circuit completed at the uppermost front contact and armature of relay 70.

Let it be assumed that a call is extended to the substation A through the test brush such as 52 of the connector which has been seized by the calling line and is in engagement with the multiple test terminal of substation A. Ground potential is extended through a side switch wiper such as 62 in its third or fourth position, a test brush such as 52 at the mentioned connector, through conductor 41 of Fig. 1 innermost armature and back contact of relay 6, left hand winding of line relay 5 to grounded battery. The line relay 5 is thus operated and closes the starter wire to cause the motor magnet 10 to operate. This magnet advances the brushes 11 to 18 inclusive of the primary line finder switch until the terminals of the called line are located.

Owing to the absence of ground potential on its terminal 7 the primary finder switch is stopped, at which time, relay 8 is operated in a circuit already described and thereby effects the operation of the cut off relay 6. With cut off relay actuated, the holding relay 22 is operated in a circuit completed from grounded battery, winding of this relay conductor 68, finder brush 17, innermost front contact and armature of relay 6 and conductor 41 to ground through the side switch wiper similar to 62 at the connector that has seized the calling line. It will be understood that in this instance relay 22 operates before the subscriber at A removes his receiver from its switch hook and thereby prevents the operation of relay 20. This insures that a secondary line finder switch will not be operated to seize the primary trunk circuit just extended to the called line.

It will be understood that this disclosure is merely typical of the present invention and that there may be many variations in the same within the scope of the appended claims without departing from the spirit of this present invention.

What is claimed is:—

1. In a telephone system, pairs of telephone lines, a plurality of non-numerical switches, a pair of trunks for each of said switches, means for allotting non-numerical switches for use, means for simultaneously extending the trunks of a non-numerical switch to a pair of lines.

2. In a telephone system, a pair of telephone lines, a single line relay and a single cut off relay for said pair of lines, a non-numerical switch, trunks individual to said switch, operating means for said switch controlled by said line relay, means for operating said line relay controlled over either of said lines to initiate the actuation of said operating means and means responsive to the connection of said trunks to the said pair of lines for operating said cut off relay.

3. In a telephone system, a pair of telephone lines, pairs of trunk circuits, a plurality of non-numerical switches any one of which will serve to connect said telephone lines to a pair of trunk circuits and means for allotting switches for use.

4. In a telephone system, pairs of incoming circuits, pairs of out-going circuits, non-numerical switches any one of which is effective to connect said pair of incoming circuits to a pair of outgoing circuits, means for allotting non-numerical switches for use and means responsive to the initiation of a call over either of said incoming circuits to extend said circuits to a pair of out-going circuits through an allotted non-numerical switch.

5. In a telephone system, a pair of incoming circuits, a relay arranged to be operated

over either of said incoming circuits on the initiation of a call thereover, pairs of out-going circuits, switching mechanisms each allotted one of which is effective on operation of said relay to connect said incoming circuits to a pair of idle out-going circuits, means for allotting idle switching mechanisms for use and means responsive to the connection of said incoming circuits to said out-going circuits for removing said relay from the control of the incoming circuits.

6. In a telephone system, pairs of incoming circuits, non-numerical switches, a pair of out-going circuits for each non-numerical switch, means for allotting idle switches for use, a relay for said incoming circuits arranged to be energized over the two sides of either of said incoming circuits in series, means responsive to the operation of said relay for causing the allotted non-numerical switch to extend its pair of out-going circuits to said incoming circuits and means for releasing this established connection.

7. In a telephone system, a plurality of non-numerical switches each switch being provided with sets of brushes and fixed terminals arranged to be engaged by said brushes, incoming circuits terminating in said fixed terminals, out-going circuits terminating in said sets of brushes, means for extending said incoming circuits to said out-going circuits through one of said switches, trunk circuits and means for extending said outgoing circuits to said trunk circuits.

8. In a telephone system, a plurality of non-numerical switches each of which is provided with sets of brushes and fixed terminals arranged to be engaged by said brushes, incoming circuits terminating in the fixed terminals of said switches, out-going circuits for each set of brushes, means for allotting said switches for use and means responsive to the initiation of a call over any of said incoming circuits for extending said incoming circuits to out-going circuits through an allotted switch, trunk circuits and means for connecting outgoing circuits to said trunk circuits.

9. In a telephone system, a plurality of primary non-numerical switches, incoming circuits and out-going circuits terminating in said switches, means for allotting idle primary switches for use, means for extending incoming circuits simultaneously to out-going circuits through an allotted primary switch, secondary non-numerical switches in which said out-going circuits terminate, trunk circuits, means for allotting secondary switches for use and means including allotted secondary non-numerical switches for extending out-going circuits to idle trunk circuits.

10. In a telephone system, a pair of incoming circuits, pairs of outgoing circuits, means for allotting out-going circuits for

use, means for connecting a pair of incoming circuits to a pair of allotted out-going circuits when a call is initiated over one of said incoming circuits, trunk circuits each provided with a pair of branches accessible to either one of the allotted pair of out-going circuits and means responsive to the connection of one of said out-going circuits to one of said branches of said trunk circuit for rendering the other branch inaccessible to the other out-going circuit of the pair. 10

In witness whereof, I hereunto subscribe my name this 23rd day of May, A. D. 1921.

WINFRED T. POWELL.