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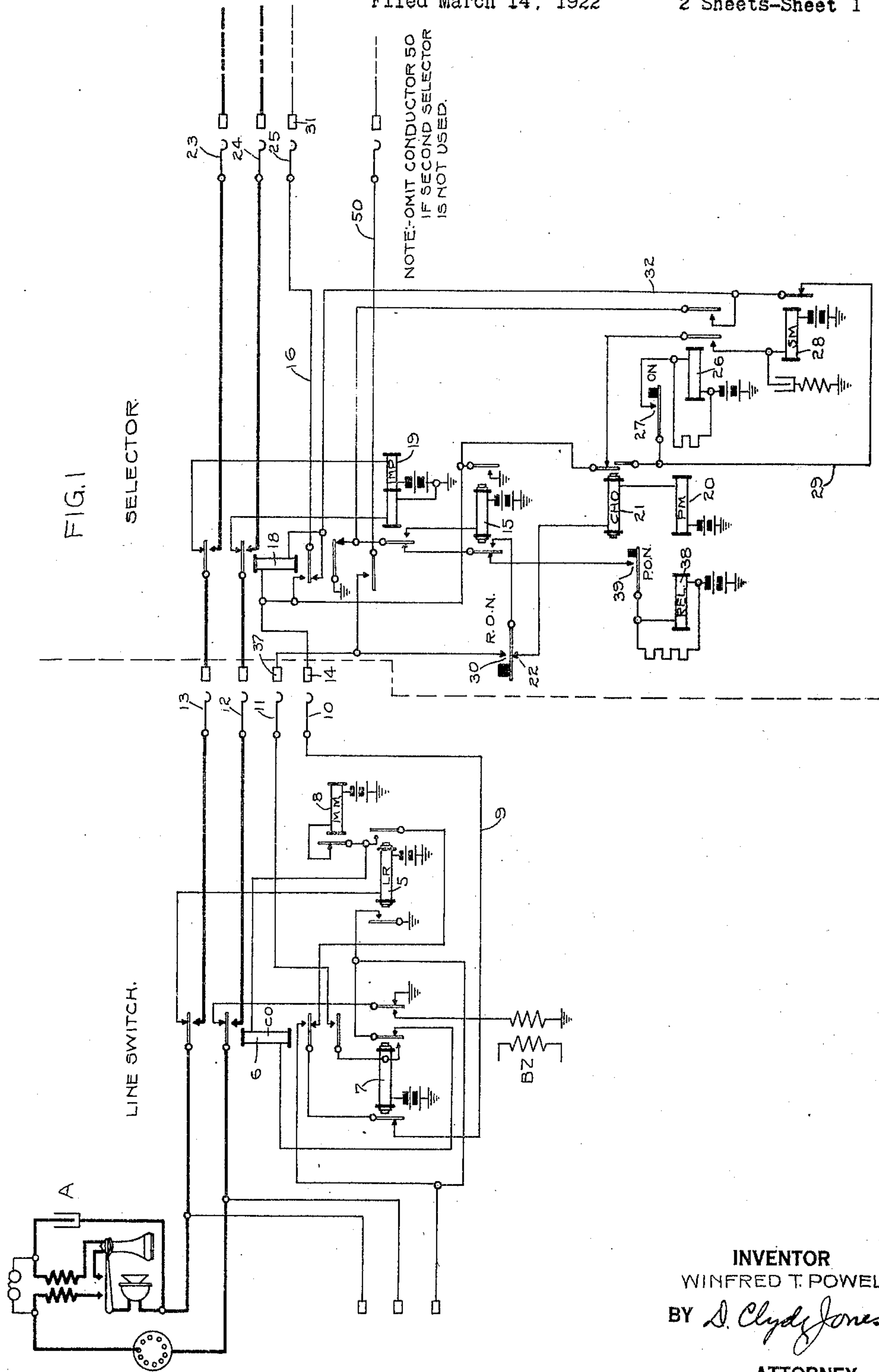
W. T. POWELL

1,564,020

AUTOMATIC TELEPHONE SYSTEM

Filed March 14, 1922

2 Sheets-Sheet 1



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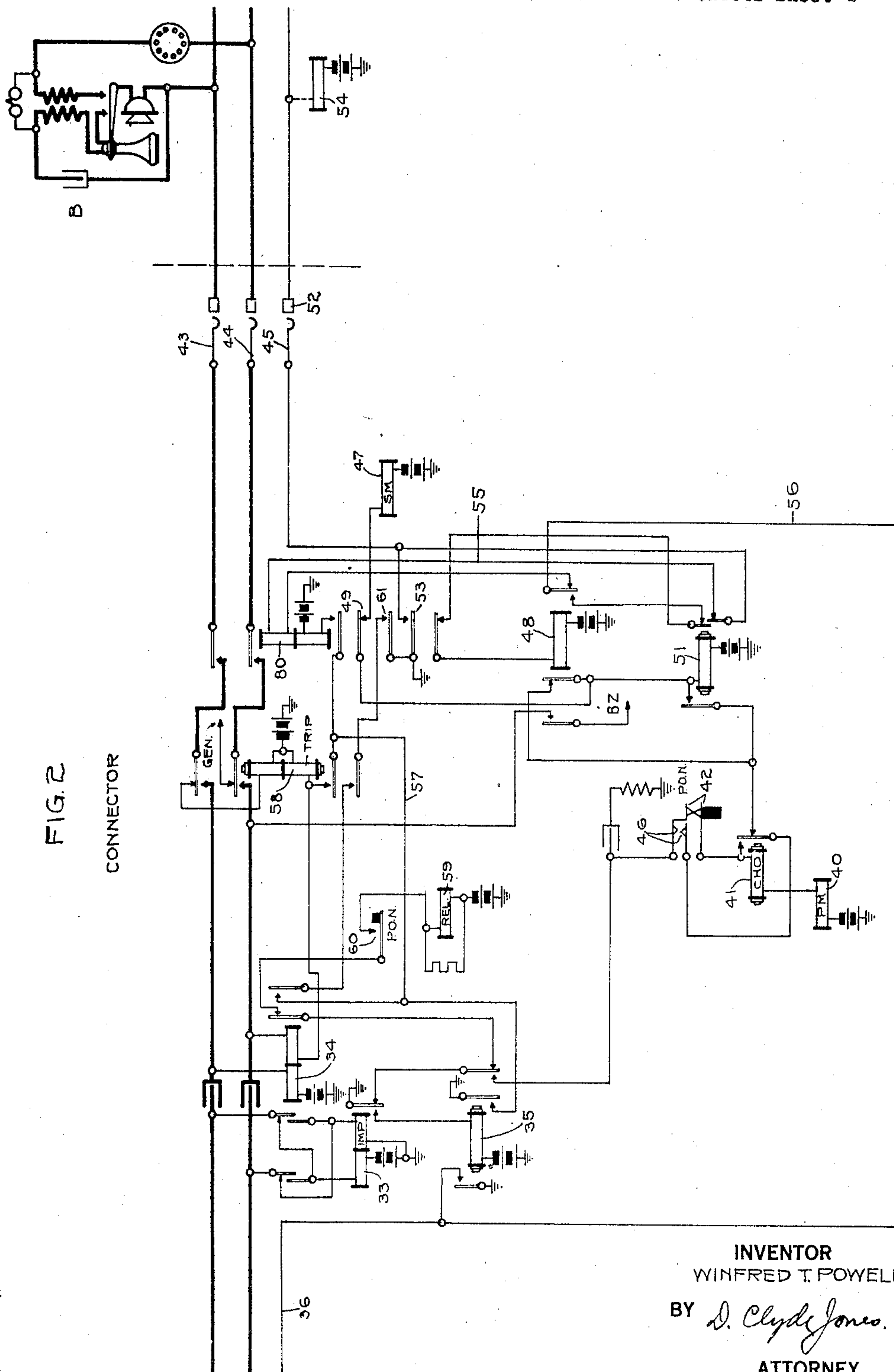
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AUTOMATIC TELEPHONE SYSTEM

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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 March 14, 1922. Serial No. 543,697.

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 completing some portion of a telephone connection.

In automatic telephone systems in which the automatic switches are directive controlled by directive impulses as distinguished from those controlled by revertive impulses, it frequently happens that the time interval between the various series of impulses except those corresponding to the tens and units digit of the wanted number, are of such short duration that it does not permit a long enough period for the trunk hunting operation of the various selector switches. If a series of impulses is transmitted before a selector switch has completed its trunk hunting operation it results that the call is either mutilated, resulting in the calling of wrong parties, or else the call is lost altogether. Under either condition one or more trunk circuits are uselessly held busy until the calling subscriber abandons the call, although these trunks are of no use to the subscriber after the mutilation of the call. This condition is particularly aggravated in periods of heavy traffic when the selectors rotate more, with the result that numerous trunks are uselessly withheld from service for a brief period.

It is the purpose of the present invention to provide for the immediate release of all the operated selector switches and their associated trunks, as soon as a connection fails, because a series of impulses has been transmitted to a selector switch before it has completed its trunk hunting operation.

The drawings with Figs. 1 and 2 in the order named diagrammatically represent a portion of a telephone system including the present invention. The portion of the drawing of Fig. 1 at the left of the dotted line represents the calling subscriber's line with substation circuits connected thereto, as well

as an individual line switch of this line, while that portion of the drawing at the right of Fig. 1 diagrammatically represents the operating circuits of a selector switch.

At the left of the dotted line of Fig. 2 there are represented the operating circuits of a connector or final numerical switch, while at the extreme right of this figure there is represented a called telephone line and the substation circuits connected to this line.

The line switch herein referred to may be substantially similar to that disclosed in the patent to Clement #1,107,153 patented August 11, 1914, while the selector switch and the connector switch herein referred to may be substantially similar to those switches disclosed in the patents to Keith, Erickson & Erickson #815,321 and #815,176 issued March 13, 1906. While these last mentioned numerical switches are arranged for operation in a so-called three-wire system, it will be readily understood how they may be modified to operate in a so-called two-wire system such as that disclosed in the present application.

With this brief outline of the mechanical structure of the system used, it is believed that the system 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 the line relay 5 is energized in a circuit closed from grounded battery, winding of this relay, upper back contact and armature of the cut-off relay 6, over the upper side of the calling line and through the substation circuits in series, over the lower side of the calling line, inner upper armature and back contact of cut-off relay 6, outer armature and back contact of relay 7 to ground. As a result of the energization of the line relay 5, an operating circuit is closed for the motor magnet 8 traceable from grounded battery, winding, back contact and armature of this magnet, front contact and armature of line relay 5, inner lower back contact and armature of relay 6, left hand armature and back contact of relay 7, conductor 9, test brush 10 and a test terminal similar to 14

of busy trunks, which are characterized by the presence of ground potential applied at the right hand armature and front contact of relay 15 or over the holding conductor 16 as will be hereinafter pointed out. Under the control of this circuit the motor magnet 8 advances the brushes 10 to 13 inclusive until the test brush 10 encounters the test terminal of a trunk which is characterized by the absence of potential. Let it be assumed that the first idle trunk tested is that shown in Fig. 1. This failure of the test brush 10, to further engage a busy test terminal, results in the discontinuing of the operating circuit of the motor magnet 8. During the period that the motor magnet is operating, a circuit is completed for the cut-off relay 6 closed from grounded battery, winding, back contact and armature of the motor magnet 8, winding of relay 6, back contact and armature of relay 7, left hand front contact and armature of relay 5 to ground. This circuit is not effective, since the cut-off relay 6 is shunted until the operating circuit of the motor magnet 8 is no longer completed. Then the circuit described for the cut-off relay 6 becomes effective and this relay attracts its armatures to extend the two sides of the calling line through its upper armatures and front contacts through the line switch brushes 12 and 13 and thence through the windings of the impulse relay 19 in series, through the upper armatures and back contacts of the switching relay 18. The impulse relay 19 is thus energized and completes an energizing circuit for the slow releasing relay 15 extending from grounded battery, winding of this relay, front contact and armature of relay 19, middle back contact and armature of relay 18 to ground. Relay 15 is energized in this circuit and completes a holding circuit for the cut-off relay 6 traceable from ground, at the front contact and armature of relay 15, test terminal 14, test brush 10, conductor 9, back contact and armature of relay 7, inner lower armature and front contact of relay 6, inner armature and back contact of relay 7, winding of cut-off relay 6, armature, back contact and winding of motor magnet 8 to grounded battery.

The selector switch is now in condition to receive impulses corresponding to the first digit of the wanted number. In response to each of these impulses the impulse relay 19 vibrates its armature and closes an operating circuit for the primary motor magnet 20 from grounded battery, winding of this magnet, winding of the change-over relay 21, contacts 22 of the off-normal switch which remains closed until the secondary movement of the selector switch is started, front contact and armature of relay 15, back contact and armature of relay 19, back contact and middle armature of relay 18 to

ground. In response to each of these directive impulses this circuit is closed and the primary motor magnet 20 advances the selector switch brushes 23, 24 and 25 one step in their primary movement to select a wanted group of trunks. At the first completion of the operating circuit of the motor magnet 20 the slow releasing change-over relay 21 is energized and holds its armatures attracted until the close of this series of impulses. Also after the first primary step of the selector switch, the relay 26 is operated in the circuit extending from grounded battery, winding of this relay off-normal contacts 27, armature and continuity spring of relay 21, armature and front contact of relay 15 to ground. When the change-over relay 21 deenergizes at the close of this series of impulses the relay 26 is locked operated from grounded battery, its winding, off-normal contacts 27, conductor 29, back contact and armature of secondary motor magnet 28, outer front contact and armature of relay 26, middle back contact and armature of relay 18 to ground.

With the relay 26 operated and with the change-over relay 21 deenergized, an operating circuit is closed for the secondary motor magnet 28 from grounded battery, winding of this magnet, inner front contact and armature of relay 26, back contact and continuity spring of relay 21, armature and front contact of relay 15 to ground. In response to the closure of this circuit the motor magnet 28 advances the brushes 23, 24 and 25 one step, into engagement with the terminals of the first trunk of the selected group. At this time the rotary off-normal contacts 22 are opened and the contacts 30 are closed. As soon as the motor magnet 28 operates, it opens the locking circuit of the relay 26, but if the trunk with which the selector brushes are in engagement is busy, a condition indicated by the presence of ground potential on its test terminal such as 31, then the relay 26 will be again operated in a circuit from grounded battery, its winding, off-normal contacts 27, conductor 29, back contact and armature of magnet 28, conductor 32, back contact and armature of relay 18, conductor 16, test brush 25, test terminal 31 to ground. When relay 26 is again operated the secondary motor magnet 28 will advance the selector switch brushes an additional step to bring them into engagement with the terminals of the second trunk circuit.

Let it be assumed that the first idle trunk circuit tested, is the one shown at the right of Fig. 1, leading to the connector switch of Fig. 2. It will be noted that during the period in which the selector switch is operating, a circuit is completed for the switching relay 18 from grounded battery, winding of relay 26, off-normal contacts 27, conductor 29, back contact and armature of

magnet 28, conductor 32, winding of relay 18, armature and front contact of relay 15 to ground. This circuit, however, is ineffective to operate the relay 18 owing to the fact that it is short circuited by ground applied through conductor 16. When an idle trunk is reached however, this short circuit is removed and the relay 18 is operated to extend the calling line through its upper armatures and front contact, through selector brushes 23 and 24 and both windings of the impulse relay 33 in series, through the back contacts and continuity springs of relay 34. The impulse relay 33 is energized in this circuit and closes a circuit for energizing the slow releasing relay 35. This last mentioned relay closes a locking circuit for the relay 18 traceable from ground, left hand armature and front contact of relay 35, conductor 36, test terminal 31, test brush 25, inner armature and front contact of relay 18, winding of this relay, conductor 32, armature and back contact of magnet 28, conductor 29, off-normal contacts 27, winding of relay 26 to grounded battery. The relay 26 does not remain energized in series with relay 18.

During busy periods when many of the trunks are busy it frequently happens that the trunk hunting operation is of relatively long duration, and if, as frequently happens, the calling subscriber dials a succeeding series of impulses closely following the first, then the selector switch will not have time to complete its operation. This will result in the mutilation of a call, and since it then becomes necessary to start the connection anew, circuits are provided which will immediately release the portion of the connection established. Let it be assumed that while the secondary motor magnet 28 is advancing the brushes 23, 24 and 25 the subscriber at A sends a second series of impulses. At this time relay 18 will not be operated so that this series of impulses is transmitted to the impulse relay 19. In response to the first of this second series of impulses the relay 19 will retract its armature and a release circuit is closed from ground, middle armature and back contact of relay 18, armature and back contact of relay 19, armature and front contact of relay 15, off-normal contacts 30, now closed, terminal 37, brush 11 of the line switch, lowermost front contact and armature of relay 6, winding of slow releasing relay 7 to grounded battery. Relay 7 is energized in this circuit and opens the holding circuit of the cut-off relay 6 causing this relay to deenergize and open the operating circuit of the relay 19. Shortly after the deenergization of this relay 19, the slow releasing relay 15 retracts its armature to complete a circuit for the release magnet 38 from grounded battery, winding of this magnet, off-normal contacts 39, back contacts and armatures of

relays 15, 19 and 18 to ground. The operation of the release magnet 38 is effective to restore the selector switch to its normal position. When cut-off relay 6 retracts its armatures the line relay 5 will again be energized since the calling subscriber at A is still on the line but this time the circuit of the line relay is closed through the outer front contact and armature of relay 7, winding of the induction coil to ground. With the line relay 5 energized a locking circuit is closed for the slow releasing relay 7 completed from grounded, battery, winding of this relay, its front contact and armature, front contact and armature of line relay 5 to ground. At the outer right hand armature and front contact of relay 7, a source of busy tone current is applied to the calling line to inform the subscriber that a connection cannot be completed. It should be noted that the operation of the relay 7 opens the operating circuit of the motor magnet 8, so that this magnet will not operate and the circuit for the relay 6 is opened to prevent the seizure of any trunk circuit.

If this arrangement is used in a large system, one or more selector switches of the same character as that shown at the right of Fig. 1 will be interposed at the points where the heavy line conductors are shown broken, so that if the first selector has completed its operation to select a second selector but this second selector is improperly operated due to the hurried dialing of the series of impulses, then the first and second selector switches as well as the line switch will be released in the manner already described. It will of course, be understood that any number of selectors or trunk hunting switches may be employed in a connection and as has been indicated, each of these switches will be provided with the features of this invention.

It has already been pointed out how the calling line is extended through the line switch brushes 12 and 13 and the selector brushes 23 and 24 to the windings of the impulse relay 33 of the connector switch. It has also been shown that the impulse relay 33 is thus actuated to operate the slow releasing relay 35. The connector switch circuits are therefore in condition to receive a series of impulses corresponding to the tens digit of the wanted number. In response to the first impulse of the tens series of impulses, an operating circuit is closed for the primary motor magnet 40, from grounded battery, winding of this magnet, winding of the change-over relay 41, off-normal contacts 42, outer front contact and armature of relay 35, back contact and armature of relay 33 to ground. Under the control of this circuit the primary motor magnet advances its brushes 43, 44 and 45 one step in their primary direction, causing

the contacts 42 to be opened, and closing the contacts 46. It will be noted that the change-over relay 41 is energized in series with the primary motor magnet and in response to the remaining impulses of this series the primary motor magnet is operated in a circuit now traceable from grounded battery, winding of this magnet, winding of the change-over relay 41, its front contact and armature, off-normal contacts 46, outer front contact and armature of relay 35, back contact and armature of relay 33 to ground. In response to each of these impulses the connector switch continues to advance its brushes in their primary direction.

At the close of the tens series of impulses, the change-over relay 41 deenergizes and prepares an operating circuit for the secondary motor magnet 47. In response to the impulses of the units series of impulses relay 33 vibrates its armature and closes a circuit from ground, armature and back contact of this relay, armature and front contact of relay 35, off-normal contacts 46, armature and back contact of relay 41, inner back contact and armature of relay 48, armature 49 and back contact of relay 80, winding of the secondary motor magnet 47 to grounded battery. In response to each of these impulses, the motor magnet 47 advances the brushes 43, 44 and 45 in their secondary direction over terminals of the lines of the selected group. It should be noted that the slow releasing relay 51 is energized in a circuit in multiple with that just described for the motor magnet and when once operated closes a locking circuit for itself, through its left hand armature and front contact, which circuit is maintained during the units series of impulses. At the close of this series of impulses when the selector brushes are in engagement with the terminals of the wanted line, but before the slow releasing relay 51 deenergizes, the test of the wanted line is made.

If the wanted line is busy, its test terminal 52 will be characterized by the presence of ground potential thereon and the test relay 48 will be operated in a circuit traceable from grounded battery, winding of this relay, lowermost armature and back contact of relay 80, continuity spring and armature of relay 51, test brush 45, and test terminal 52 to ground at the connector, that has previously seized the wanted line, which ground is applied through a multiple terminal similar to 52 and a test brush similar to 45 and an armature similar to 53 and its front contact to ground. The relay 51 deenergizes and the test relay 48 is then locked operated in a circuit extending from grounded battery, winding of this relay, lowermost armature and back contact of relay 80, continuity spring and back contact

of relay 51, right hand front contact of relay 48, conductor 56, left hand front contact and armature of relay 35 to ground. This last mentioned circuit is maintained until the connection is disestablished. At the outer armature and front contact of relay 48, a source of busy tone current is applied to the calling line to inform the calling subscriber that the wanted line is busy.

Let it be assumed that when the test of the called line is made that it is idle, under which condition, battery potential will be present on its test terminal 52, this will prevent the operation of the test relay 48 but the switching relay 80 will be operated in a circuit closed from grounded battery, cut-off relay 54 of the wanted line, test terminal 52, test brush 45, armature and back contact of relay 51, conductor 55, upper winding of relay 80, armature and back contact of relay 48, conductor 56, front contact and armature of relay 35 to ground.

Relay 80 attracts its armatures to complete a ringing circuit and also locks itself operated in a circuit including grounded battery, its lowermost winding, front contact and armature, conductor 57, inner front contact and armature of relay 35 to ground. Ringing current is now applied over a ringing circuit closed from the ringing generator (not shown) through the upper armature and back contact of the trip relay 58, inner, upper front contact and armature of relay 80, connector brush 44, over the lower side of the wanted line and the called bell of the substation circuits, over the upper side of the wanted line, connector brush 43, uppermost armature and front contact of relay 80, upper winding of trip relay 58 to grounded battery. Ringing current is supplied over this circuit until the called party responds at which time the trip relay is operated to disconnect the source of ringing current from the wanted line. The trip relay 58, when operated, locks itself in this condition through its lower front contact and armature, over conductor 57 to ground. It should be noted at this point that the uppermost contact of the trip relay 58 is adjusted so that the locking circuit is completed before this contact is opened. When the trip relay operates it closes a set of break points in the called subscribers portion of the connection.

Talking current is supplied to the called subscriber through windings of relay 34, which causes this relay to attract its armatures and reverse the direction of current being supplied to the calling party. This reversal of current is effective for controlling message charging devices or for other similar purposes. Talking battery is supplied to the calling subscriber through the windings of the relay 33.

At the termination of the conversation when the calling subscriber replaces his re-

ceiver on its switch hook, the impulse relay 33 deenergizes and shortly afterwards the slow releasing relay 35 deenergizes. This opens the holding conductor 36 which permits the switching relay 18 in Fig. 1 to deenergize and close an operating circuit for the release magnet 38, this circuit is closed from grounded battery, winding of release magnet 38, off-normal contacts 39, back contacts and armatures of relays 15, 19 and 18 to ground. Also the opening of conductor 36 permits the release of the cut-off relay 6 which causes the line switch to revert to its normal condition.

The release of the connector switch is controlled by the subscriber of the connection that hangs up his receiver last. In the event that the calling subscriber is the last to hang up his receiver, the impulse relay 33 deenergizes and shortly afterwards the relay 35. At this time relay 34 is deenergized so that an operating circuit is closed for the release magnet 59 of the connector switch, from grounded battery, winding of this magnet, off-normal contacts 60, back contacts and armatures of relays 34, 35 and 33 to ground. The release magnet 59 on energization restores the connector switch to normal condition. In the event that the called subscriber is the last to hang up his receiver, at this time the impulse relay 33 and the slow releasing relay 35 are deenergized and the connection is now controlled by the relay 34 which has a substitute holding circuit for itself through its right hand winding, inner, lower front contact and armature of the trip relay 58, outer front contact and armature of relay 34, lowermost front contact and armature of relay 58, contact 61 and armature of relay 80 to ground. It will also be noted that the locking circuits for the trip relay 58 and switching relay 80 are completed in multiple with that just described. When the called subscriber replaces his receiver on its switch hook, the relay 34 deenergizes which opens the locking circuits of the relays 80, 58 and 34 but closes the energizing circuit for the release magnet 59 from grounded battery off-normal contacts 60, back contacts and armatures of relays 34, 33 and 35 to ground. This apparatus is now in its normal condition in readiness to be used in the next call.

What is claimed is:—

1. In an automatic telephone system, a plurality of telephone lines, a plurality of primary trunks, an automatic switch for connecting a calling telephone line to any idle primary trunk, a numerical switch for each primary trunk arranged for directive movement in response to impulses and trunk hunting movements, secondary trunks terminating in said numerical switches, means for sending several series of impulses over said telephone line, means responsive to the first

series of impulses for directly operating said numerical switch, means operating at the termination of the first series of impulses for causing said numerical switch to hunt for an idle trunk, means effective to release said numerical switch if a second series of impulses is transmitted over said telephone line before said numerical switch has completed its trunk hunting operation, and means for notifying the calling subscriber of the release of said numerical switch.

2. In an automatic telephone system, a plurality of telephone lines, a plurality of primary trunks, a primary switch for connecting a calling telephone line to an idle primary trunk, a numerical switch for each primary trunk, secondary trunks terminating in said numerical switches, means associated with each telephone line for transmitting several series of impulses, means for operating each numerical switch directly in response to a series of impulses and automatically to perform a trunk hunting operation, a holding circuit extending from said primary switch to the selected numerical switch on the seizure of the same, and means associated with said primary switch for opening said holding circuit if the second series of impulses is transmitted over said telephone line during the trunk hunting period of said numerical switch.

3. In a telephone system, a plurality of telephone lines, a plurality of trunk circuits, means including a non-numerical switch and numerical switches together with said trunk circuits for extending a telephone connection from a calling telephone line in the direction of a wanted telephone line, means associated with the calling telephone line for transmitting several series of impulses to control said numerical switches, and means for releasing all the switches in the connection if one of said series of impulses is sent prematurely and for preventing temporarily the operation of said non-numerical switch.

4. In a telephone system, a plurality of telephone lines, a plurality of trunk circuits, means including non-numerical switches and numerical trunk hunting switches together with said trunk circuits for extending a telephone connection from a calling telephone line in the direction of a wanted telephone line, means associated with the calling telephone line for transmitting several series of impulses to control said numerical switches and means for restoring all the switches in the connection if one of said series of impulses is sent prematurely, and means for notifying the calling subscriber of such restoring operation.

5. In a telephone system, a plurality of telephone lines, a plurality of trunks, a primary switch for extending a calling telephone line to an idle trunk, a numerical

trunk hunting switch individual to each trunk, secondary trunks terminating in said numerical switches, an impulse relay associated with each numerical switch, said relay being controlled over a calling telephone line and a selected trunk in series, means for operating a selected numerical switch directly and subsequently automatically in its trunk hunting movement, means responsive to the seizure of an idle secondary trunk by said numerical switch for removing the impulse relay from the control of said telephone line, and a relay at said primary switch and a circuit for the same extending through contacts of said impulse relay, said relay when operated effecting the restoration of the primary switch and the selected numerical switch.

6. In a telephone system, a plurality of telephone lines, a plurality of primary trunk circuits, automatic switching means for extending a calling telephone line to an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary trunks terminating in said numerical switches, a holding conductor extending between said switching means and a selected numerical switch as soon as said selected numerical switch is seized, an impulse relay at each numerical switch responsive to impulses from the calling telephone line, means for disabling said impulse relay when its associated switch has seized a secondary trunk, a relay for interrupting the holding circuit of said switching means and said numerical switch, and a circuit for said relay controlled by the operation of one of said impulse relays during the trunk hunting operation of said selected numerical switch.

7. In a telephone system, a plurality of telephone lines, impulse senders associated therewith, a plurality of primary trunk circuits, automatic switching means for extending a calling telephone line to an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary trunks terminating in said numerical switches, a holding conductor extending between said switching means and a selected numerical switch as soon as the same are connected together, a relay for interrupting the holding circuit of said switching means and said numerical switch, and a circuit for said relay closed responsive to one or more impulses from an impulse sender during the trunk hunting operation of said numerical switch.

8. In a telephone system, a plurality of telephone lines, means associated with each telephone line for transmitting several series of impulses, a plurality of primary trunks, switching means for interconnecting a calling telephone line with an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary trunks

terminating in said numerical switches, means including other numerical trunk hunting switches and trunks for further extending a telephone connection, means at each of said numerical switches for directly operating its numerical switch in response to impulses from said impulse transmitting means, means also located at each numerical switch for causing said switch to be advanced automatically to select idle trunks, means associated with one of said switches functioning if the same is prematurely operated to restore the switches of the portion of the connection already established, and means for notifying the calling subscriber of such restoring operation.

9. In an automatic telephone system, a plurality of telephone lines, a plurality of primary trunks, automatic switching means for interconnecting a calling telephone line and an idle primary trunk, means at each telephone line for transmitting series of impulses, a numerical trunk hunting switch for each primary trunk, secondary trunks and trunk hunting switches individual thereto, tertiary trunks with numerical trunk hunting switches individual thereto, means for directly and automatically operating said numerical switches in succession, restoring means associated with said switching means, a circuit for said restoring means extended in succession to said numerical switches on the seizure of the same, means operating in response to impulses during the trunk hunting operation of any numerical switch of a connection for actuating said restoring means, and means operating temporarily to prevent the connection of the calling line to a primary trunk.

10. In an automatic telephone system, a plurality of telephone lines, means associated with each telephone line for transmitting series of impulses, a plurality of primary trunks, a non-numerical switch for each telephone line for extending the same when calling to idle primary trunks, a motor magnet for advancing each non-numerical switch, a line relay energized over the calling telephone line, a cut-off relay for disconnecting said line relay from said telephone line, a control relay at said line switch, an operating circuit for said control relay, means effective on the seizure of an idle trunk for operating said cut-off relay and for maintaining the same operated during the connection, a numerical trunk-hunting switch for each primary trunk, secondary trunks terminating in said numerical switches, and means at each numerical switch for operating said switch in response to impulses from an impulse transmitting device and for subsequently operating said numerical switch independently of impulses to seize an idle secondary trunk, said control relay being effective to restore the line

switch of the calling line and the selected numerical switch in response to a premature series of impulses.

11. In an automatic telephone system, a plurality of telephone lines, an impulse sender for each telephone line, a plurality of primary trunks, switching means for extending a calling line to an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary trunks terminating in said numerical switches, operating means for each numerical switch responsive to a series of impulses to select a wanted group of secondary trunks, means for subsequently causing the selected numerical switch to hunt for an idle trunk in a selected group, an impulse relay controlled over a selected primary trunk and a calling line and responsive to impulses for controlling the directive operation of said numerical switch, a switching relay at said numerical switch for disabling said impulse relay on the seizure of an idle secondary trunk, a sequence relay for disabling the trunk hunting mechanism of said numerical switch during the directive operation of said impulse relay to control the operation of said switch, an off-normal switch associated with said numerical switch, and means effective on the receipt of impulses by said impulse relay while said switching relay and said sequence relay are deenergized and when said off-normal contacts are closed, for effecting the release of the portion of the connection already connected.

12. In a telephone system, a plurality of telephone lines, primary trunks, switching mechanism for extending a calling telephone line to an idle primary trunk, a numerical switch for each primary trunk, secondary trunks terminating in said numerical switches, each of said primary and secondary trunks including a pair of talking conductors, a combined test and holding conductor for maintaining the connection already established, a fourth conductor, and means controlled over said fourth conductor responsive to the receipt of a premature series of impulses for disabling said holding conductor.

13. In a telephone system, a plurality of telephone lines, an impulse sender for each telephone line, a line switch for the use of each telephone line, trunks terminating in said line switches, a numerical trunk hunting switch for each primary trunk responsive to a series of impulses from an impulse sender, a motor magnet for advancing the line switch of the calling line to seize an idle trunk, a line relay controlled over the two sides of the calling line in series on the initiation of a call, a cut-off relay and a control relay associated with said line switch, a circuit for said motor magnet extending through contacts of said line relay and said

control relay, means responsive to the seizure of an idle trunk for actuating said cut-off relay to discontinue the operation of said line relay, a circuit for said control relay extending to the selected numerical switch through contacts of said cut-off relay, means at said numerical switch operating in response to a premature series of impulses for closing the circuit of said control relay, a locking circuit for said control relay completed on its energization, means responsive to the operation of said control relay for restoring the associated line switch and selected numerical switch, and means including said control relay for preventing the operation of said cut-off relay.

14. In an automatic telephone system, a plurality of telephone lines, an impulse sender for each telephone line, a plurality of primary trunks, switching means for extending a calling line to an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary trunks terminating in said numerical switches, operating means for each numerical switch responsive to a series of impulses to select a wanted group of secondary trunks, means for subsequently causing the selected numerical switch to hunt for an idle trunk in the selected group, an impulse relay associated with the selected numerical switch and controlled over the selected primary trunk and a calling telephone line, said impulse relay being responsive to impulses from said impulse sender for controlling the operating means of said numerical switch, means responsive to the operation of said impulse relay during the trunk hunting operation of said selected numerical switch for interrupting the connection including the calling telephone line and the selected primary trunk, and means responsive to said interruption for releasing said operated switching means and said selected numerical switch.

15. In an automatic telephone system, a plurality of telephone lines, impulse senders associated therewith, a plurality of primary trunks, automatic switching means for extending a calling telephone line to an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary trunks terminating in said numerical switches, a relay associated with the operated automatic switching means for effecting the release of said switching means and the selected numerical trunk hunting switch, and means associated with said selected numerical trunk hunting switch and operated responsive to the receipt of directive impulses at said selected numerical switch during its trunk hunting operation for actuating said relay.

16. In an automatic telephone system, a plurality of telephone lines, impulse senders associated therewith, a plurality of primary

trunks, automatic switching means for extending a calling telephone line to an idle primary trunk, a numerical trunk hunting switch for each primary trunk, secondary
5 trunks terminating in said numerical switches, a relay associated with the operated automatic switching means for causing the release of said switching means and the selected numerical trunk hunting switch,
10 means associated with said selected numerical trunk hunting switch and operated responsive to the receipt of directive impulses at said selected numerical switch during its trunk hunting operation for operating said
15 relay, and means controlled by said relay for signaling said calling telephone line.

17. In an automatic telephone system, a plurality of telephone lines, a plurality of trunks, means including a non-numerical
20 switch for interconnecting a calling telephone line with an idle trunk on the initiation of a call, a numerical switch for each trunk, means associated with the calling telephone line for sending series of impulses
25 to control said numerical switches, and

means for releasing all the switches of the connection if a certain series of impulses is sent prematurely, and for preventing the calling telephone line from being connected to a trunk circuit again until said calling
30 telephone line terminates the call.

18. In an automatic telephone system, a telephone line, an impulse sender associated with said telephone line, a line relay operable over said telephone line, a control relay,
35 a plurality of trunks, means including non-numerical and numerical switches for extending said telephone line when calling to one of said trunks, said impulse sender being operable to directively control said nu-
40 merical switches, releasing means for said switches governed by said control relay, means for operating said control relay in response to a premature series of impulses, and a locking circuit for said control relay
45 completed at said line relay.

In witness whereof, I hereunto subscribe my name this 9th day of March A. D. 1922.

WINFRED T. POWELL.