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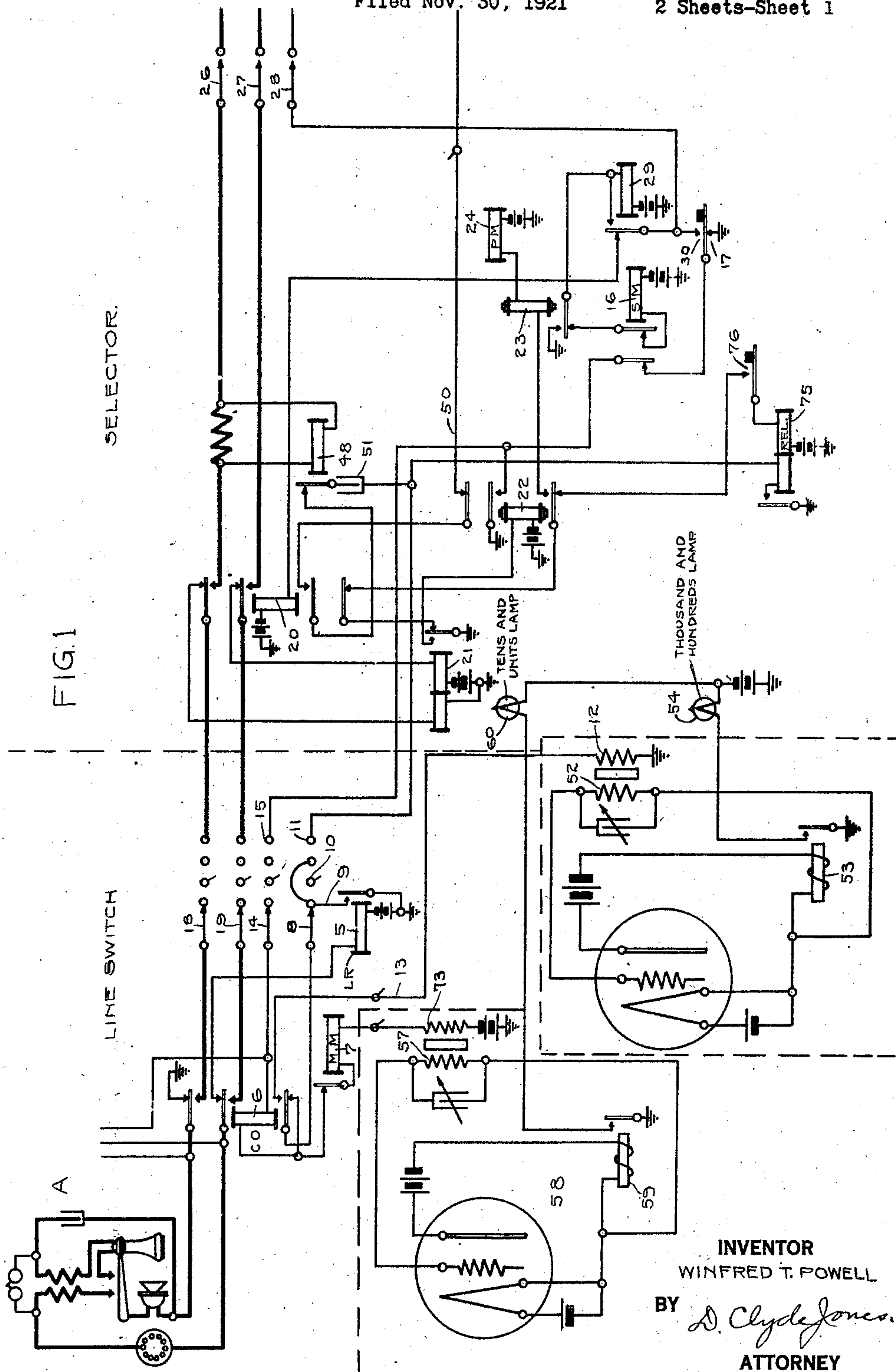
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1,569,676

AUTOMATIC TELEPHONE SYSTEM

Filed Nov. 30, 1921

2 Sheets-Sheet 1



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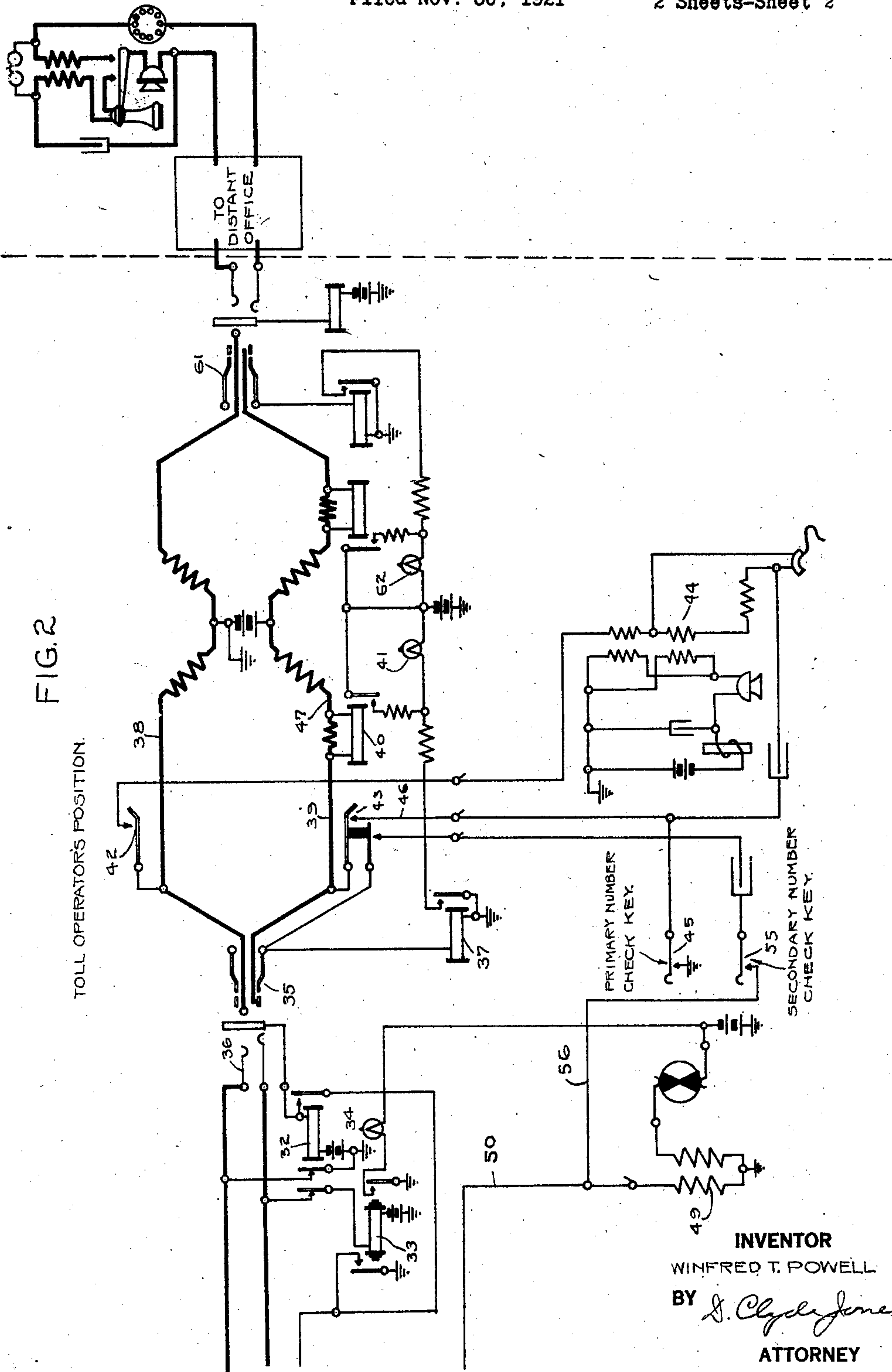
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UNITED STATES PATENT OFFICE.

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 November 30, 1921. Serial No. 518,874.

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 automatic telephone systems and more particularly to line indicating devices in such telephone systems.

In telephone systems employing automatic switches in completing some portion of a telephone connection, it becomes necessary when a calling subscriber desires to obtain a toll connection by directly setting one or more automatic switches to complete a connection with the toll operator's position, to provide some means for indicating the designation of the calling line so that the toll operator can check the number of the calling line as given by this subscriber, in order to correctly charge for the toll connection.

In accordance with one feature of the present invention means are provided whereby alternating current is employed to actuate a line indicating device or devices.

In accordance with another feature of this invention means are provided including a rectifying device such as a detector of the thermionic type or of the crystal type for controlling a line indicating device.

The drawings with Fig. 2 placed at the right of Fig. 1 diagrammatically represent portions of a telephone system including the present invention. At the upper left hand corner of Fig. 1 there is represented the substation circuits and the individual line switch of a telephone line. At the right of the dotted line in Fig. 1 there are represented the circuits of a selector switch which functions to select trunks leading to an idle operator's position. At the lower left hand corner of Fig. 1 there are represented two thermionic devices which co-operate in the indication of the number of the calling switch.

At the left of the dotted line in Fig. 2 there appears a cord circuit and an operator's telephone set of a toll operator's position. At the right of the dotted line of Fig. 2 there is indicated a called telephone line, and the rectangle including the legend

"To distant office" indicates that one or more operators co-operate to complete the desired telephone connection.

The structure of the line switch and the selector are now well known and it is not necessary to describe the same. It is only necessary to point out that in a 10,000 line system there will be 200 lamps such as those designated 54 and 60, which lamps are visible to a plurality of operators and each lamp such as 54 indicates the thousands and hundreds digit of the calling line, while the lamp such as 60 indicates the tens and units designation of the calling line.

It is believed that the invention will best be understood by describing the method of extending a calling telephone line to an idle toll operator's position, checking the number of the calling subscriber and then manually extending the connection to a called subscriber. When the calling subscriber at A removes his receiver from its switch hook the line relay 5 is energized through a circuit extending 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 at A, over the upper side of the calling line, armature and back contact of the cut-off relay 6 to ground. The line relay 5 is energized in this circuit and completes an operating circuit for the motor magnet 7 of the line switch individual to the calling line, which circuit is traceable from grounded battery, primary winding 73 of the induction coil, winding of the motor magnet 7 its back contact and armature, lowermost back contact and armature of the cut-off relay 6, test brush 8 of the line switch, conductor 9, front contact and armature of the line relay to ground. Under the control of this circuit the primary line switch leaves the normal position in which it was resting and proceeds to test the terminals such as 10 and 11 of trunk circuits leading to selector switches.

Let it be assumed that the trunk circuit whose test terminal, which is designated 10, is busy, which condition is indicated by the presence of ground potential on the terminal 10. This busy potential is applied from ground through a primary winding similar to 12 of an induction coil, a conductor simi-

lar to 13, lowermost front contact and armature of a cut-off relay similar to 6 and a test brush similar to 8 at the line switch which has previously seized the trunk circuit now being tested. The motor magnet 7 will now continue to advance the brushes 8, 14, 18 and 19 of the line switch until an idle test terminal such as 11 is reached, this idle test terminal 11 is characterized by the absence of ground potential, so that the cut-off relay 6 which has been shunted during this operation of the motor magnet is now actuated in a circuit traceable from grounded battery, primary winding 73 of the induction coil, winding, back contact and armature of the motor magnet 7, winding of the cut-off relay 6 holding brush 14, holding terminal 15, outer armature and back contact of the secondary motor magnet 16, off normal contacts 17 to ground. The motor magnet 7 is marginal and will not operate in series with the cut-off relay 6 so that the line switch will be stopped with its brushes in engagement with the trunk circuit shown at the right of Fig. 1. As soon as the cut-off relay 6 is operated it extends the two sides of the calling line to the brushes 18 and 19 of the line switch through the upper armature and back contact of relay 20, left hand winding of the impulse relay 21 to ground and through the inner upper armature and back contact of relay 20 through the right hand winding of the impulse relay 21 to grounded battery.

As soon as the impulse relay 21 attracts its armature it closes an operating circuit for the slow releasing holding relay 22 and this last relay at its inner armature and front contact closes a substitute circuit independent of the off normal contacts 17.

The subscriber at A will now operate his dial sender to transmit one or more impulses corresponding to the designation of the toll operator. Let it be assumed that the subscriber is instructed to dial "0" which transmits a series of ten impulses to signal the toll operator. In response to each of these impulses the impulse relay 21 retracts its armature to close a circuit from ground, its armature and back contact, lowermost armature and back contact of relay 20, lower armature and front contact of relay 22, winding of the slow releasing change-over relay 23, winding of the primary motor magnet 24 to grounded battery. In response to each of these ten impulses transmitted to the impulse relay 21, the primary motor magnet 24 will advance the brushes 26, 27 and 28 of the selector switch to the tenth group of trunks terminating in this switch. At the close of this series of impulses, the impulse relay 21 will hold its armature attracted for a relatively long interval which results in the deenergization of the change-

over relay 23. During the time that the change-over relay 23 is operated, a circuit is closed for energizing the test relay 29. This circuit is closed at the armature and front contact of the relay 23 and the test relay 29 as soon as it is operated, locks itself actuated in a circuit traceable from grounded battery, its winding, front contact and armature, contacts 30, outer back contact and armature of the secondary motor magnet 16, inner front contact and armature of relay 22 to ground.

When the change-over relay 23 deenergizes an operating circuit is closed for the secondary motor magnet 16 from grounded battery, its winding back contact and armature, back contact and armature of relay 23, front contact and armature of the test relay 29 in multiple with the locking circuit of the test relay to ground at the front contact and armature of the holding relay 22. The secondary motor magnet 16 is thus actuated to advance the brushes 26, 27 and 28 into engagement with the terminals of the first trunk of the selected group, also the secondary motor magnet when operated interrupts the locking circuit of the test relay 29. If, however, the first trunk tested by the test brush 28 is busy, a condition indicated by the presence of ground potential on its test terminal, the test relay 29 will, therefore, be held operated and the secondary motor magnet 16 will be energized to advance the brushes of the selector switch over the terminals of busy trunks.

Let it be assumed that the first idle trunk tested is that indicated at Fig. 2 which has no ground potential on its test terminal so that the test relay 29 will de-energize and prevent further operation of the secondary motor magnet. Switching relay 20 will then be operated at this time in a circuit which may be traced from grounded battery, winding of this relay, back contact and armature of the test relay 29, off-normal contacts 30 to ground at the front contact and armature of the holding relay 22. The switching relay serves to extend the calling line through the brushes 26 and 27 of the selector switch and through the back contacts and armatures of relay 32 to ground and to grounded battery, through the winding of the slow releasing relay 33. The slow releasing relay attracts its armatures and at its left hand armature and front contact closes the holding circuit for the switching relay 20. At the right hand armature and front contact of relay 33, a circuit is closed for lighting the lamp 34 for indicating to the operator that a call is awaiting her attention.

As soon as the switching relay 20 attracts its armatures it opens the energizing circuit of the impulse relay 21, which immediately deenergizes and opens the circuit of the

holding relay 22 but this relay is sluggish and holds its armature operated to maintain a holding circuit for the line switch until the slow releasing relay 33 of Fig. 2 is operated to complete a substitute holding circuit for this switch.

The operator notes that the lamp 34 is lighted; inserts an answering plug 35 of a cord circuit at her position into the jack 36 associated with the lamp 34. Relay 32 will then be operated in a circuit completed from grounded battery, its winding, sleeve contacts of the jack and plug, winding of relay 37 to ground. The holding circuit is now extended through the front contact of relay 32 to ground through the winding of relay 37. The calling line has thus been extended to the conductors 38 and 39 of the cord circuit and thence over conductor 38 through winding of the repeating coil to ground and over conductor 39 through the supervisory relay 40 and the winding of the repeating coil to grounded battery. The supervisory relay attracts its armature and thereby prevents the lighting of the answering supervisory lamp 41. As soon as the operator has inserted the plug 35 into the jack 36 she depresses a listening key the contacts of which are designated 42 and 43 to connect her telephone set generally designated 44, to the calling telephone line. The operator then receives the wanted number from the calling subscriber and also requests the number of the calling line.

It now becomes necessary to check the number of the calling line to determine whether or not the calling subscriber has truthfully given the number of his substation. The operator then depresses the primary lamp key 45 which closes a circuit from ground through the contacts of this key, conductor 46, through contacts of the listening key 43, winding of the supervisory relay 40, conductor 47, lower winding of the repeating coil to grounded battery. This circuit is effected to short circuit the relay 48 which has been maintained energized in the circuit including the two sides of the calling line and the trunk and cord circuits in series to ground and grounded battery, through the left hand windings of the repeating coil. The relay 48 thereupon deenergizes and the source of alternating current is extended in a circuit traceable from ground, secondary winding of the induction coil 49, conductor 50, uppermost back contact and armature of relay 22, lower armature and front contact of relay 20, back contact and armature of relay 48, through the condenser 51, terminal 11 and brush 8 of the line switch, lower armature and front contact of the cut-off relay 6, conductor 13, primary winding 12 of the induction coil to ground. This alternating current is then repeated to the secondary winding 52 of the

induction coil which forms a part of the tuned circuit including a part of the circuits of the vacuum tube detector as is well known. This alternating current which is repeated to the tuned circuit and the vacuum tube detector rectifies this current to make the relay 53 responsive thereto. In the event that the rectified current transmitted to the relay 53 is not sufficient for its operation an additional vacuum tube arranged as an amplifier may be employed in addition to the detector, so that the current repeated to relay 53 will cause its operation and when relay 53 is operated, a circuit is closed at its armature and contact to light the lamp 54. This lamp indicates the thousands and hundreds portion of the designation of the calling line.

The operator thereupon depresses the secondary lamp key 55 to close a circuit for the alternating current from ground through the winding of the induction coil 49, conductor 56, key contacts 55, the condenser contacts of the listening key 43, sleeve contacts of the plug 35 and of the jack 36, front contact and armature of relay 32, selector test brush 28, off normal contacts 30, outer back contact and armature of secondary motor magnet 16, test terminal 15, holding brush 14 of the primary line switch, winding of the cut-off relay 6, back contact, armature and winding of the motor magnet 7, primary winding 73 of the induction coil to grounded battery. This alternating current is repeated through the secondary winding 57 of the induction coil included in the tuned circuit of the detector generally designated 58. The detector 58 rectifies the alternating current and effects the operation of the relay 59 which in turn lights the lamp 60 which lamp indicates the tens and units designation of the calling substation.

After having thus determined that the calling subscriber has truthfully given the number of the calling line the operator then proceeds to complete the call in the well known manner by inserting the calling end of her cord circuit into the jack of the trunk leading to the distant office through which the called subscriber may be reached. The toll operator, after the connection has been completed, makes the charge record of the call for the calling subscriber in accordance with the usual practice.

At the termination of the call when the calling subscriber replaces his receiver on its switch hook, the supervisory relay 40 will release its armature and thereby remove the shunt circuit from the answering supervisory lamp 41, which is, therefore, lighted informing the toll operator that the call is terminated. The operator then removes the plug 35 from the jack 36 which effects the release of the relay 32. As soon as relay 32 deenergizes it permits the deenergization of

the switching relay 20, whereupon, a circuit is closed for the release magnet extending from grounded battery, right hand winding of this magnet, off normal contacts 76, back contact and armature of relay 22, back contacts and armatures of relays 20 and 21 to ground. The release magnet will thus be operated until the selector switch has been restored to normal at which time the off-normal contacts 76 are opened. With the magnet 75 energized a circuit is closed from ground, its armature, front contact and left hand winding, terminal 11 of the line switch, brush 8, lower armature and back contact of relay 6 now deenergized, back contact, armature and winding of the motor magnet 7, primary winding 73 of the induction coil to grounded battery. Under the control of this circuit the motor magnet 7 advances the brushes of the line switch to some one of its sets of normal contacts.

In this description thermionic devices have been employed to detect and amplify a source of current which in turn control the operation of the number checking lamps, it will be understood, however, that any other devices which function in a manner similar to this device may be employed.

What is claimed is:—

1. In a telephone system, a plurality of telephone lines, each having a different arbitrary designation, an operator's position, means for connecting a calling telephone line to said operator's position, a line indicating device a source of alternating current associated with said operator's position, and means responsive to the same number of applications of said source of alternating current in all cases and effective after the initiation of calls on said lines for actuating said indicating device in accordance with the designations of said telephone lines.

2. In a telephone system, a plurality of telephone lines, each having a different arbitrary designation, an operator's position, means for connecting calling telephone lines to said operator's position, a line indicating device, a source of alternating current associated with said operator's position, and means including a current rectifying device responsive to the same number of applications of said alternating current on the initiation of calls over the calling telephone line for actuating said lines indicating device in accordance with the designations of said calling telephone lines.

3. In a telephone system, a plurality of telephone lines, each having a different arbitrary designation, an operator's position, means for connecting a calling telephone line to said operator's position, a line indicating device at said operator's position for indi-

cating the designation of calling telephone lines, and manually controlled means including an electron discharge device invariably operated in the same manner in several cases for actuating said indicating device effective after a calling line is connected to said operator's position.

4. In a telephone system, a plurality of telephone lines, each having a different arbitrary designation, an operator's position, a line indicating device for signalling the designation of calling telephone lines, a source of alternating current of low magnitude, and means including a device sensitive to and responsive to the same number of application of said alternating current in the case of a plurality of telephone lines for causing the actuation of said line indicating device after the initiation of a call on one of said telephone lines.

5. In a telephone system, a plurality of telephone lines, an operator's position, means for connecting a calling telephone line to an operator's position, a visual line indicating device including electron tubes for indicating two different portions of the designation of a calling line, a source of current, operating circuits for said electron tubes, and manual means for completing said circuits to said source of current.

6. In a telephone system, a plurality of telephone lines, an operator's position, means including non-numerical and numerical switches for extending a calling line to an operator's position, a line indicating device for indicating the designation of the calling line, a source of current, means including an electron discharge device for actuating said line indicating device, and means for electrically connecting said source of current and said electron discharging device after the connection of the calling line to said operator's position by said non-numerical and numerical switches.

7. In a telephone system, a plurality of telephone lines, each telephone line having a different arbitrary designation, an operator's position, means for connecting a calling telephone line to said operator's position, a line indicating device and a source of current at said operator's position, electron discharge devices for variably operating said line indicating device to signal the designation of calling telephone lines, and means operable after the extension of a calling line to said operator's position for connecting said source of current to said electron discharging device.

In witness whereof, I hereunto subscribe my name this 28th day of November A. D. 1921.

WINFRED T. POWELL.