

Sept. 18, 1923.

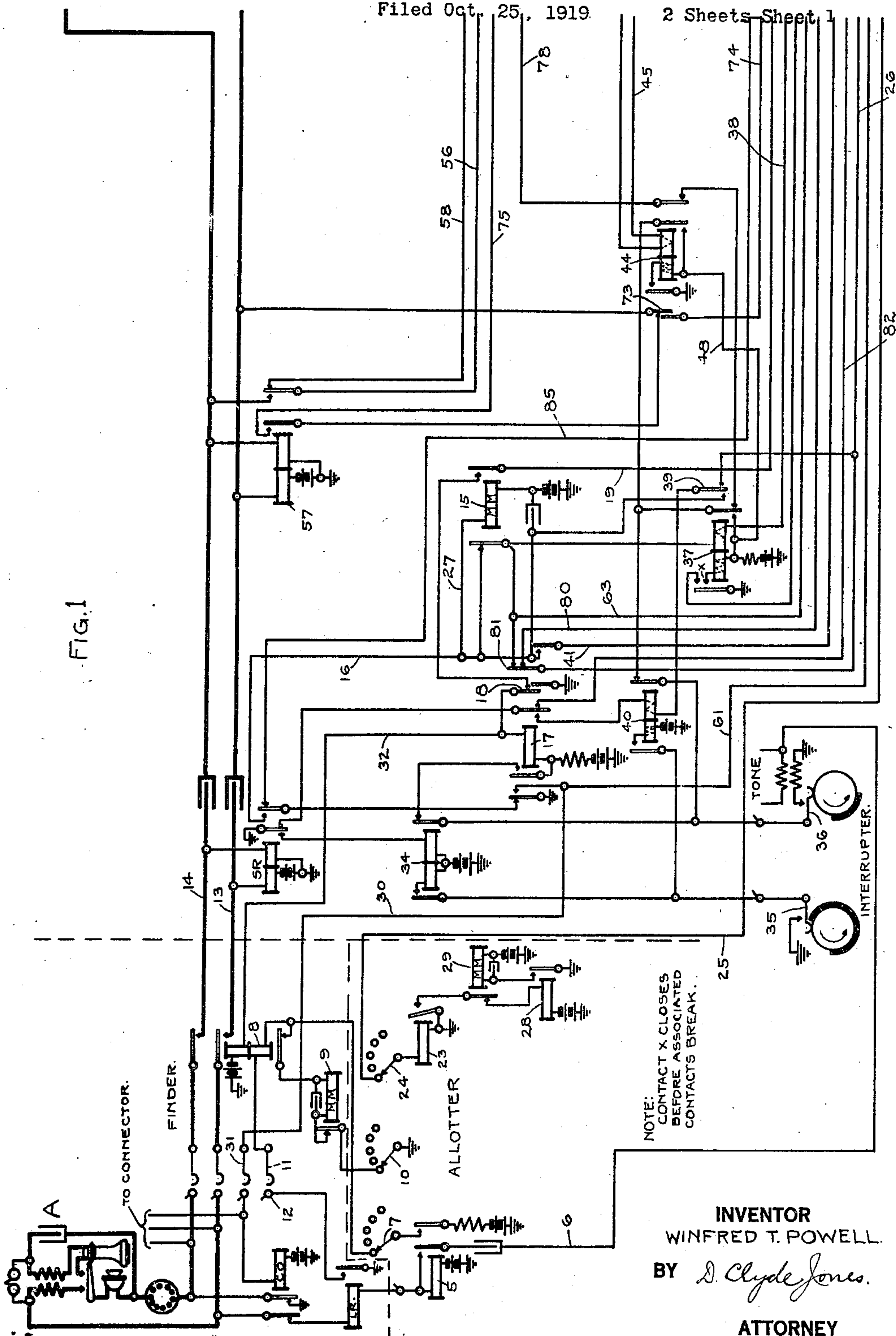
W. T. POWELL

1,468,249

AUTOMATIC TELEPHONE SYSTEM

Filed Oct. 25, 1919.

2 Sheets Sheet 1



Sept. 18, 1923.

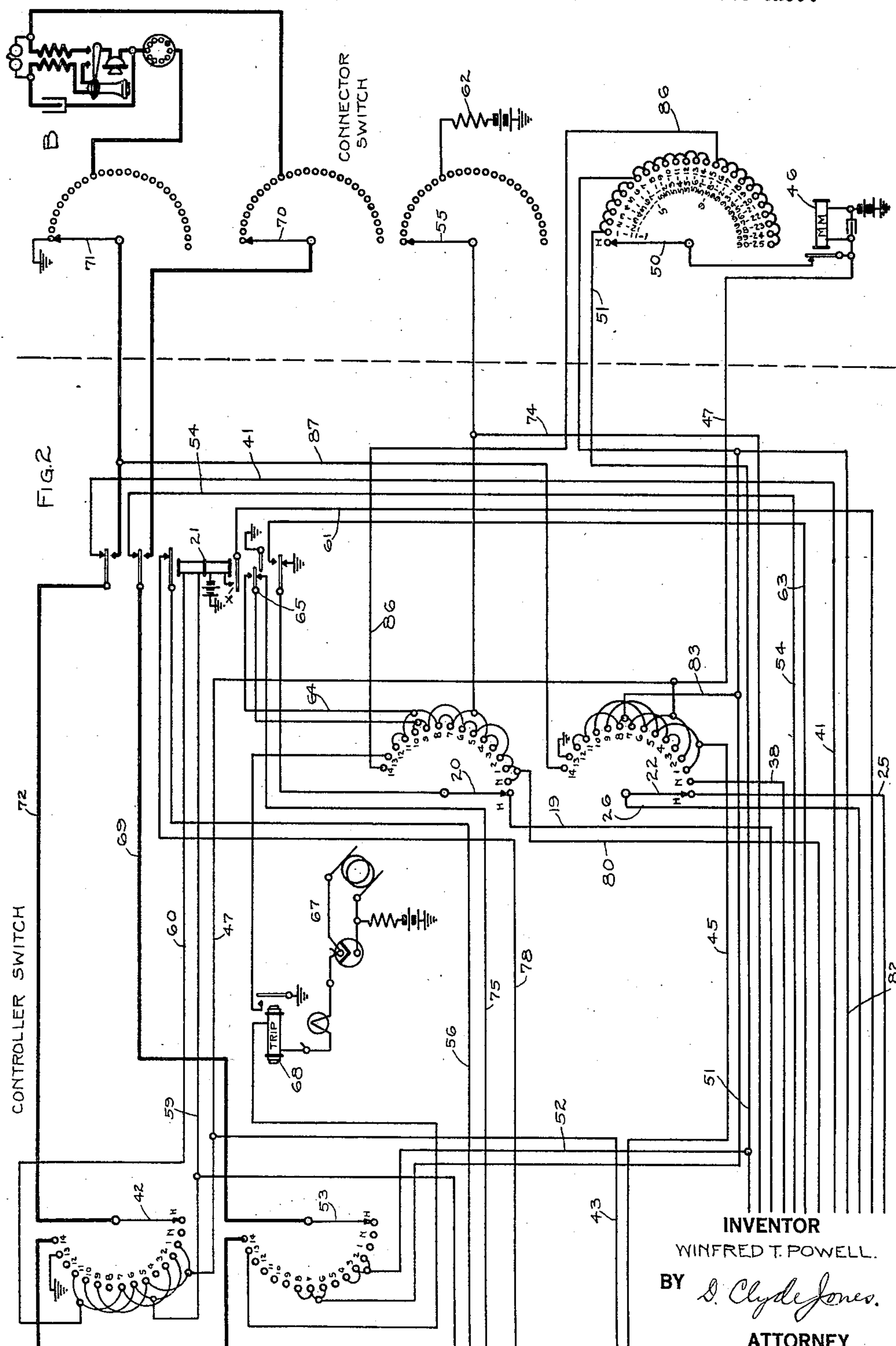
1,468,249

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed Oct. 25, 1919

2 Sheets-Sheet 2



Patented Sept. 18, 1923.

1,468,249

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 October 25, 1919. Serial No. 333,236.

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 machine switching in interconnecting calling and called telephone lines.

The present invention has for its purpose the provision of an automatic telephone system in which small unidirectional switches that are structurally the same, are employed in connecting calling lines to trunks and thereupon connecting these trunks to wanted telephone lines.

The main feature of this invention is the provision of means for setting a connector switch under the control of a sequence governing and registering device.

A further feature of the invention is the provision of translating means individual to a numerical switch, so that this switch will assume a desired setting other than that indicated by the impulse sender.

The drawings with Fig. 1 placed at the left of Fig. 2 diagrammatically represent a portion of a telephone system incorporating the present invention. The portion of the drawings shown at the upper left hand corner of Fig. 1 represents a calling telephone line and the operating circuits of a finder switch for connecting this telephone line to an idle trunk. The portion of the drawings shown at the lower left hand corner of Fig. 1 represents an allotter switch for assigning trunks or link circuits for use in succession. The remainder of the drawings show the operating circuits of a connector switch, as well as a portion of the circuits of the called telephone line. The connector has a controller switch shown at the right of Fig. 1 and the left hand portion of Fig. 2. At the right of the dotted line in Fig. 2 there is diagrammatically shown the structural representation of the connector switch.

The finder, controller and connector switches may be of the uni-directional rotary

type, and substantially similar to the switch shown in the patent to Clement, #1,107,153, patented Aug. 11th, 1914. The allotter may be similar in structure to the other mentioned switches, except that it is of smaller capacity.

As shown, the system is arranged to accommodate a relatively small number of lines, but it will be understood that if the invention is employed in a system having a relatively large number of lines, that it will be necessary to have the allotted finder switch extend the calling line to a selector switch, which in turn will select an idle connector leading to the wanted line.

An impulse sender is provided for each substation which may be of any well known type that is arranged to cause momentary interruptions in a so called "two wire" circuit for controlling automatic switches.

An interrupter is also employed which consists of two interrupting elements operating to close circuits in predetermined time intervals.

In certain instances it is necessary that certain contacts of some of the relays be closed before their associated contacts are switched. Contacts which are so adjusted have been designated X.

Certain numerals are associated with the bank contacts with which connector brush engages. The numbers 1, 5 and 9 are opposite the contacts to which the connector brushes are advanced when the tens digits 1, 5 or 9 respectively, are dialed, that is, they mark the beginning of the groups of lines at the connector. The second series of numerals indicate the numbers which must be dialed to advance the connector brushes to any desired point, while the next series of numerals indicate the number of this contact from the home position.

It is believed that the invention will best be understood by describing the method of extending a call from a calling line designated A to a called substation at B. Let it be assumed that the allotter has assigned for use the trunk in Fig. 1. When the calling party A removes his receiver from its switchhook, a circuit is closed from grounded battery, winding of common start relay 5, winding of the line relay LR, outer back contact of the cut off relay CO, through the substation circuits, inner arma-

ture and back contact of the cut off relay to ground. The relays 5 and LR are energized in this circuit, and the relay 5 through its armature and front contact closes conductor 6 leading to a tone device which will apply a tone to the calling line until this line has been connected to an idle trunk. This tone therefore indicates to the subscriber that he should not operate his dial sender until the tone ceases, otherwise some of the directive impulses will be lost and a wrong connection will result. However, if this dialing tone is not desired, the conductor 6 may be omitted.

At the outer armature and front contact of relay 5, a circuit is closed from grounded battery, resistance, allotter brush 7, lower back contact and armature of the switching relay 8, winding of the motor magnet 9 of the finder, back contact and armature of this magnet, and allotter brush 10 to ground. Under the control of this circuit the motor magnet 9 advances the brushes of the finder switch until the test brush 11 encounters test terminal 12 of the calling line which has been grounded by the energization of the line relay LR. When this occurs, a circuit is closed from grounded battery, resistance, outer armature and front contact of relay 5, allotter brush 7, lower winding of relay 8 to ground over test brush 11. It will be noted that this last described circuit shunts the motor magnet 9 of the finder switch to stop the same, and also energizes the switching relay 8 which connects the calling line to the selected idle trunk.

As soon as the switching relay 8 has completed its operation, the stepping relay SR of the connector is energized over the trunk conductors 13 and 14 and the line and substation circuits in series. Under the control of this circuit, stepping relay SR operates its armatures and in turn causes the energization of relay 34. The motor magnet 15 of the controller is thereupon energized in a circuit traceable from grounded battery, winding of the motor magnet 15, conductor 16, outer armature and front contact of the stepping relay SR, left hand back contact and armature of relay 17 to ground. The motor magnet 15 is energized in this circuit and attracts its armature to complete an operating circuit for the relay 17 extending from grounded battery, resistance, winding of the relay 17, its continuity spring 18 and contact, right hand front contact and armature of the motor magnet 15, conductor 19, brush 20 of the controller in its "home" position, lowermost armature and back contact of switching relay 21 to ground. The relay 17 which remains energized until the time of release when it deenergizes to permit the controller switch to move to its "home" position, is operated and attracts its armatures. At its continuity spring 18 and

armature, it closes a locking circuit for itself to ground. At the outer left hand armature and back contact of relay 17, the energizing circuit of the motor magnet 15 of the controller is interrupted, causing the controller to move into its next position which has been designated a "normal" position.

As soon as the relay 17 attracts its armatures, a circuit is closed from ground, outer left hand armature and front contact of relay 17, conductor 30, holding brush 31 of the finder switch, winding of the cut-off relay CO to grounded battery. This circuit also places a guarding potential on the test terminal of the calling line at the connector to prevent its seizure as a called line. The cut-off relay operating disconnects the line relay and also the dial tone previously mentioned. At the right hand armature and continuity spring 18 of the relay 17, ground is applied to conductor 32, upper winding of the switching relay 8 to grounded battery to hold this relay energized after the allotter has broken its original energizing winding.

As soon as the controller brush 22 leaves its "home" position, the energizing circuit of the relay 23 which is energized as long as the allotter brushes are standing in a position to assign an idle trunk, releases. The energizing circuit of the relay 23 extends from ground, winding of this relay, allotter brush 24, conductor 25, controller brush 22 in its "home" position, conductor 26, outer armature and back contact of relay 17, armature and back contact of the motor magnet 15, conductor 27, winding of the motor magnet 15 to grounded battery.

When the relay 23 deenergizes, it closes a circuit for a relay 28 which co-operates in the control of the motor magnet 29 of the allotter switch. This relay 28 insures that the allotter will advance its brushes slowly enough so that it will have an opportunity to test for idle trunks. The relay 28 is energized over a circuit controlled at the back contact and armature of the magnet 29 and at the back contact and armature of relay 23. The relay 28 attracts its armature to close an operating circuit for the motor magnet 29 of the allotter, so that this magnet will advance the brushes of the switch one step. It also opens the circuit of the relay 28 causing the relay 28 to open the operating circuit of the motor magnet 29. It will thus be seen that there is an inter-operation between the relay 28 and the magnet 29 with the result that the allotter operates slowly enough to insure accuracy in testing. Under the control of the circuits just described, the motor magnet 29 advances the brushes of the allotter until the allotter brush 24 engages a test terminal on which there is battery potential applied over a circuit similar to that described as including the controller brush 22 in its

"home" position. When such a test terminal is reached, the relay 23 will be energized to open the circuit of the controlling relay 28 and relay 23 will remain operated until the newly assigned trunk is taken for use. The apparatus is now in condition to receive the impulses from the dial sender at the substation A. Since only a connector switch has been shown, it is necessary to transmit a tens series of impulses to advance the connector switch to a desired group of lines, and thereafter directly operate the switch to select a wanted line in the selected group. In accordance with the present invention, the connector is arranged so that it need not be advanced a number of steps equal to the number of impulses transmitted from the dial sender, but assumes a setting under certain conditions predetermined by the controller which in the case of the tens series of impulses acts as a translating device.

It will first be assumed that the wanted line is in the first group of lines terminating in the connector switch under which assumption one impulse of current will be transmitted by the dial sender to cause the connector switch to take a setting in operative relation to the first group of lines terminating at the switch. It will then be assumed that the wanted line is in the second group of lines terminating at the connector under which condition it will be necessary to transmit five impulses, and lastly it will be assumed that the wanted line is in a third group of lines at the connector switch under which assumption it will be necessary to transmit a series of nine impulses.

Before proceeding further with the description of the operation of the connector it might be well to point out that the double interrupter which controls brushes 35 and 36 is effective to govern the operation of the so-called "change-over" function and release operations of the connector switch. This device controls the release magnet 34 and the change-over relay 40. Brushes 35 and 36 are closed in predetermined intervals and the circuit is completed through brush 36 whenever the circuit is closed through brush 35. In the case of the change-over operation it is necessary that the controller remain in one position during a series of impulses, but to advance out of this position at the close of this series of impulses. It therefore becomes necessary to measure an interval of time greater than that between two impulses of a series, in which interval the control switch must not be advanced, but when a period longer than this interval transpires the circuit must be closed to advance the controller to a succeeding position. It will appear further in the description that during the receipt of a series of impulses, the circuit will be intermittently closed through the right-hand winding of the

change-over relay 40, and a locking circuit through the right-hand winding of this relay is intermittently closed at the brush 35, so that it may happen during the period of receiving the series of impulses that the relays 40 will have its armatures retracted which is one of the conditions necessary to effect the change-over, but at this time the circuit will be open at brush 36. In order to effect the change-over the circuit must be opened through the right-hand winding of the change-over relay and an interval of time must have lapsed sufficient to open the circuit through brush 35 before the circuit controlling the change-over extending through brush 36 and the right-hand armature and back contact of relay 40 is effective. This will appear from the further description of operation of the connector switch. A similar time interval is measured for controlling the release operation and this likewise will appear from the following description.

Since it has been assumed that the wanted line is in the first group of lines terminating at the connector, the subscriber will then transmit one impulse corresponding to the first digit of the wanted member. The stepping relay SR will retract its armature once and then remain energized until the units series of impulses. When the stepping relay SR retracts its armature, it opens the energizing circuit of the restoring relay 34. This relay will be locked energized through its left hand winding if interrupter brush 35 is connected to ground. If, however, the interrupter brush 35 is not closed to ground, the restoring relay will close a break point in the restoring circuit at its armature and back contact, but before interrupter brush 36 is closed to ground to complete this circuit after ground has been removed at interrupter 35, the stepping relay SR will attract its armatures to energize relay 34 again. Therefore the restoring circuit for the connector switch controlled at the back contact and armature of the restoring relay 34 is ineffective as long as the calling party has his receiver from its switchhook. When the stepping relay SR retracts its armatures in response to an impulse corresponding to the tens digit of the wanted number, the motor magnet 15 of the controller is energized in a circuit completed from grounded battery, winding of this magnet, conductor 27, armature and back contact of the motor magnet, the right hand winding of relay 37, conductor 38, the controller brush 22 in its "normal" position, conductor 26, armature 39 and back contact of relay 37, right hand winding of relay 40, inner right hand front contact and armature of relay 17, inner back contact and armature of stepping relay SR to ground. The motor magnet 15 and the relays 40 and 37 are en-

energized in this circuit. Relay 37 locks itself energized through its left hand winding, front contact and armature. The right hand winding of this relay is opened at this time at its outer right hand contact and armature 39. Relay 40 has a locking circuit intermittently closed through its left hand winding, front contact and armature to interrupter brush 35. When the stepping relay SR is energized at the close of this impulse, it will interrupt the operating circuit of the motor magnet 15 previously described, causing this magnet to deenergize and advance the controller brushes to position one. The "change-over" relay 40 will remain energized for a relatively long interval after the transmission of the tens impulse or impulses, so that the interrupter brush 36 will have an opportunity to extend ground to the inner right hand armature and front contact of relay 37 to short circuit this relay and cause its deenergization.

The calling subscriber may now operate his dial sender to transmit impulses corresponding to the units digit of the wanted number. In response to each impulse transmitted, the stepping relay SR will vibrate its armatures. In response to the first impulse of the units series, the motor magnet 15 of the controller will be operated to advance the controller to position 2 over a circuit closed from grounded battery, winding of this magnet, conductor 27, outermost right hand front contact and armature of relay 17, conductor 41, uppermost back contact and armature of relay 21, controller brush 42 in position one, conductor 43, right hand winding of relay 44, conductor 45, brush 22 in position 1, conductor 26, armature 39 and back contact of relay 37, right hand winding of the "change-over" relay 40, innermost right hand front contact and armature of relay 17, inner back contact and armature of the stepping relay SR to ground. The motor magnet 46 of the connector is also energized at this time in a circuit extending from grounded battery, winding of the motor magnet, conductor 47 and in multiple with the circuit previously described, over conductor 43. The motor magnets 15 and 46 as well as the "change-over" relay 40 and relay 44, are energized in this circuit. The relay 44 closes a locking circuit for itself from ground, its inner left hand armature and front contact, its left hand winding, conductor 48, through resistance to grounded battery. When the stepping relay SR is again energized after this first impulse, the circuit of the motor magnets 15 and 46 and the "change-over" relay 40 are opened causing the controller to advance its brushes into position two, and the connector to advance to position one. Thereafter each time that the stepping relay SR retracts its armature, it closes a circuit from ground, its inner

right hand armature and back contact, innermost right hand armature and front contact of relay 17, right hand winding of relay 40, armature 39 and back contact of relay 37, conductor 26, brush 22 of the controller in its second position, conductor 47, winding of the motor magnet 46 of the connector to grounded battery. In response to each of the remaining impulses transmitted to the stepping relay SR, the motor magnet 46 of the connector advances the connector brushes progressively.

It will now be assumed that the wanted line is in the second group of lines at the connector switch. It will therefore be necessary for the calling subscriber to operate his dial sender to transmit a tens series of five impulses.

It will be remembered in the case where a single tens impulse was transmitted that the motor magnet 15 caused the controller brushes to move to position one, and that the relay 37 was locked energized until the "change-over" was effected at the close of the tens series of impulses. In the present instance when the subscriber transmits five impulses for the tens digit, the motor magnet 15 of the controller will move the brushes of this switch one step for each impulse received, and when the controller reaches position two, a circuit is closed for the motor magnet 46 of the connector, conductor 47 and over conductor 43 in multiple with the operating circuit of the motor magnet 15 of the controller. In response to the second, third, and fourth impulses from the substation dial sender, the controller will be advanced through positions two, three and four. The controller will be advanced slowly through these positions, since its operation is controlled at the dial sender and while it is being thus advanced, a circuit will be closed for a sufficient interval of time to advance the connector brushes to the last line of the first group of lines terminating at the connector. This circuit for advancing the connector to the last position of the first group of lines extends from grounded battery, winding of the motor magnet 46, connector brush 50 in its positions one to six inclusive, conductors 51 and 52, controller brush 53 in its positions two, three and four, conductor 69, upper middle armature and back contact of relay 21, conductor 54, left hand front contact and armature of relay 37 to ground. At the close of the tens series of impulses, the relay 37 will be short circuited as in the case previously described, and the impulses of the second or units digit will be recorded directly on the connector to advance this switch to the wanted line in the selected group.

If the wanted line is in the third group of lines terminating at the connector, the first or tens digit of the wanted number will be

9. The operations previously described in connection with the selection of the first and second groups of lines at the connector will take place, and while the controller is being advanced through positions six, seven and eight, the connector will be advanced to point 15 which is the last line of the group whose designation is 5. At the end of the tens series of impulses as in the preceding cases, the "change-over" will occur and the second or units digit of the wanted number will be recorded directly on the connector to connect to the wanted line in the group, the designation of which is 9. If the called line is idle when the test is made, there will be no ground potential on the test terminal of the wanted line with which the test brush 55 of the connector is in engagement.

Since the controller at the time of testing the wanted line remains in the position to which it has been advanced during the tens series of impulses and the "change-over" at the conclusion of this series of impulses, the controller will be standing in positions two, six or ten depending upon whether the tens digit was one, five or nine. At the time of the "change-over" the relay 44 is short circuited by ground at interrupter brush 36 and deenergizes to close a circuit from ground, resistance, brush 36 of the interrupter, armature and back contact of relay 40, inner right hand armature and back contact of relay 37, right hand back contact and armature of relay 44, conductor 78, innermost upper back contact and armature of relay 21, conductor 56, armature and back contact of relay 57, conductor 58, brush 42 in positions two, six or ten, conductor 72, uppermost armature and back contact of relay 21, conductor 41, armature and front contact of relay 17, conductor 27, winding of the motor magnet 15 of the controller to grounded battery. Under the control of this circuit the motor magnet advances the controller brushes one step, moving them to positions three, seven or eleven depending upon the position of the brushes during the testing of the wanted line. The relay 21 is energized in a circuit extending from ground, resistance, interrupter brush 36, right hand armatures and back contacts of relays 40, 37 and 44, conductor 78, innermost upper back contact and armature of relay 21, conductor 56, armature and back contact of relay 57, conductors 58 and 59, upper winding of relay 21, conductor 60, controller brush 42 in positions three, seven or eleven, upper armature and back contact of relay 21 to grounded battery over conductor 41 and motor magnet 15. The relay 21 is operated in this circuit and closes a locking circuit for itself through its lower winding, innermost lower front contact and armature which close before associated contacts on

this relay break, conductor 61, outer left hand front contact and armature of relay 17 to ground. Relay 21 connects a guarding potential to the test brush 55 to make the test terminal of the called line busy and to operate the cut off relay of the called line herein shown as a resistance designated 62. The relay 21 closes a circuit to move the controller switch past positions three, four, seven, eight, eleven and twelve, if this switch has not already been advanced past these positions. This circuit is traceable from grounded battery, winding of the motor magnet 15 of the controller, conductor 27, back contact and armature of motor magnet 15, conductor 63, lowermost front contact and armature of relay 21, brush 20 of the controller in positions three, four, seven, eight, eleven and twelve, conductor 64, continuity spring 65 and middle lower armature of relay 21 to ground. The relay 21 also closes a circuit to advance the controller switch past positions five, six, nine and ten depending upon which position the controller was standing at the close of the testing operation. The last named circuit is completed from grounded battery, winding of the motor magnet 15 of the controller, conductor 27, back contact and armature of this magnet, conductor 63, lowermost front contact and armature of relay 21, controller brush 20 in positions five, six, nine and ten, continuity spring 65 and middle lower armature of relay 21 to ground. The operation of the relay 21 after causing the above-described operation of the controller connects the brushes of the connector to its trunk conductors, since at this time the controller is standing in position thirteen and the called subscriber will be signaled over a circuit completed from the ringing machine 67, trip relay 68, controller brush 53 in its thirteenth position, trunk conductor 69, middle upper armature and front contact of relay 21, connector brush 70, through the lower side of the called line and bell at the called station, upper side of the called line, connector brush 71, uppermost front contact and armature of relay 21, trunk conductor 72, controller brush 42 in its thirteenth position to ground. The slow releasing trip relay 68 is marginal and does not operate in this circuit until the called party responds. It will thereupon receive sufficient current to energize and attract its armature to close a circuit from ground, its armature and front contact, controller brush 20 in its thirteenth position, lowermost armature and front contact of relay 21, conductor 63, armature and back contact of the motor magnet 15 of the controller, conductor 27, winding of this magnet to grounded battery. The motor magnet 15 interrupts its own circuit to advance the brushes of the controller into their fourteenth or talking position.

Talking battery for the calling party is supplied through the winding of the stepping relay SR, while the talking battery for the called subscriber is supplied through the winding of the relay 57.

In the event that the called line is busy when tested, the test brush of the connector will encounter a ground potential on the test terminal of this line. This will cause the operation of the relay 57 of Fig. 1, over a circuit closed from grounded battery, left hand winding of relay 57, continuity spring 73 and outer left hand armature of relay 44, conductor 74, test brush 55 to ground at the connector switch which has previously seized the wanted line. When the "change-over" takes place at the close of the tens series of impulses, interrupter brush 36 closes a circuit from ground through the right hand armature and back contact of relay 40, inner right hand armature and front contact of relay 44 which shunts the relay 44 and causes it to deenergize. The relay 57 will thereupon be locked energized in a circuit now traced from grounded battery, its left hand winding, continuity spring 73 and back contact of relay 44, inner armature and front contact of relay 57, conductor 75, back contact and continuity spring 65 of relay 21, brush 20 of the controller closed in positions two, six and ten, lowermost armature and back contact of relay 21 to ground.

The busy tone is now transmitted to the calling party to inform him that the wanted line is engaged. This tone is sent over a circuit traceable from ground, winding of the transformer, brush 36 of the interrupter, right hand armature and back contact of relay 40, inner right hand armature and back contact of relay 37, outer armature and back contact of relay 44, conductor 78, innermost upper back contact and armature of relay 21, conductor 56, outer armature and front contact of relay 57 over the upper side of the trunk, and calling line and substation circuits, over the lower side of the line and trunk circuits, continuity spring 73 and back contact of relay 44, inner armature and front contact of relay 57, conductor 75, back contact and continuity spring 65 of relay 21, controller brush 20 in positions two, six or ten, lowermost armature and back contact of relay 21 to ground. The testing operation just described takes place in the same manner irrespective of whether the controller is standing in positions two, six or ten, since the same circuits are established at each of these points in multiple.

If the calling party should again operate his dial sender after receiving the busy indication, the connector switch will be advanced but the controller will remain in its testing position, that is, in positions two, six or ten so that no disturbance will result from this last mentioned operation.

When the calling party replaces his receiver on the switchhook either because he has terminated his conversation or desires to abandon the call, the stepping relay SR will have its energizing circuit opened and will retract its armatures. This will open the energizing circuit of the right hand winding of relay 34, and when interrupter brush 35 disengages its contact, the left hand winding of relay 34 will be deenergized permitting this relay to retract its armatures. In the course of the operation of the interrupter, ground will be applied over brush 36, armature and back contact of relay 34, inner left hand front contact and armature of relay 17, resistance, to grounded battery. This circuit shunts the relay 17, causing it to deenergize and retract its armatures. At the outer left hand armature and front contact of this relay the locking circuit of relay 21 including conductor 61 is opened, causing this last named relay to retract its armatures. Also at this same armature and front contact of relay 17 a holding circuit for the cut-off relay including conductor 30 is opened, removing the guarding potential from the called terminal of the calling line at the connector, and also causes its cut-off relay to reconnect the line relay to the line. At the middle armature and continuity spring 18 of relay 17, the holding circuit for the relay 8 including conductor 32 is opened to disconnect the line brushes of the finder from the trunk. After the release of relays 17 and 21, the controller is advanced to position fourteen. Ground is connected through the lowermost armature and back contact of relay 21 to the controller brush 20, and when this brush is standing in positions one, two, five, six, nine and ten, it will close a circuit over conductor 80, back contacts and armature 81 of relay 17, armature and back contact of motor magnet 15 of the controller, conductor 27, winding of this magnet to grounded battery. Under the control of this circuit the controller will be advanced through the last named positions. The controller is also advanced past positions three, four, seven, eight, eleven and twelve over a circuit closed from ground at the back contact of the stepping relay SR, innermost right hand armature and back contact of relay 17, conductors 82 and 83, brush 22 of the controller in positions three, four, seven, eight, eleven and twelve, conductor 26, armature 81 and back contact of relay 17, back contact and armature of the motor magnet 15 of the controller, conductor 27, winding of this magnet to grounded battery. When the brush 22 of the controller is standing in its thirteenth position, ground is applied over conductor 26, and the armature 81 and contact of relay 17, armature and back contact of motor magnet 15, conductor 27, winding of magnet 15 to ground.

ed battery to advance the controller to position fourteen.

The connector is advanced past points 1 to 6 inclusive, by a circuit traceable from ground, outer left hand armature and back contact of relay 17, outer armature and back contact of the stepping relay SR, conductors 85 and 51, brush 50 in positions 1 to 6 inclusive, back contact, armature and winding of the motor magnet 46 to grounded battery. The conductor is advanced past points 7 to 14 inclusive, by an operating circuit extending from ground, inner armature and back contact of the stepping relay SR, innermost right hand armature and back contact of relay 17, conductor 82, connector brush 50 in any of its positions from 7 to 14 inclusive, back contact, armature and winding of the motor magnet 46 to grounded battery. The connector is advanced past positions 15 to 25 by an operating circuit closed from grounded battery, winding, armature and back contact of this magnet 46, connector brush 50 in positions 15 to 25 inclusive, conductor 86, controller brush 20 in position fourteen, lowermost armature and back contact of relay 21 to ground. The connector has now been advanced to its "home" position and a circuit is thereupon completed from ground, through connector brush 71, conductor 87, controller brush 22 in its fourteenth position, conductor 26, armature 81 of relay 17, armature and back contact of the motor magnet 15 of the controller, conductor 27, winding of this motor magnet to grounded battery. Under the control of this circuit, the controller advances its brushes to their so-called "home" position.

It will thus be seen that a controller or sequence controlling device has been provided which also functions as a register and translating device and which stores a portion of the wanted number, and thereupon causes its associated connector switch to be adjusted to a position corresponding to the number as translated by said device.

What I claim is:

1. In a telephone system, an incoming line, a plurality of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines, and a progressively movable registering switch individual to said automatic switch and operated directly from a distant point to cause said automatic switch to take a desired setting other than that indicated by said means.

2. In a telephone system, an incoming line, a plurality of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines, and a progressively movable translating device individual to said automatic switch and operated directly from a distant point to

cause said automatic switch to take a desired setting other than that indicated by said translating device.

3. In a telephone system, an incoming line, a plurality of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines, and a progressively movable combined sequence controlling device and translating mechanism individual to said automatic switch and operated directly from a distant point to cause said switch to take a desired setting other than that indicated by said controlling device and translating mechanism.

4. In a telephone system, an incoming line, a variably adjustable impulse sender associated with said line, a plurality of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines, and a progressively movable translating switch individual to said automatic switch and directly controlled over said incoming line to take a setting in accordance with the adjustment of said impulse sender, said automatic switch during a portion of its operation being controlled by said translating means to take a desired setting other than that indicated by said impulse sender.

5. In a telephone system, an incoming line, a variable adjustable impulse sender associated with said line, a plurality of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines, a progressively movable translating switch individual to said switch and directly controlled over said incoming line to take a setting in accordance with the adjustment of said impulse sender, said automatic switch during a portion of its operation being controlled by said translating means to take a desired setting other than that indicated by said impulse sender, and during the remainder of its movement set in accordance with the adjustment of said impulse sender.

6. In a telephone system, an incoming line, a plurality of outgoing lines arranged in groups, an automatic switch operable through group and line selecting movements to interconnect said incoming line with any of said outgoing lines, and a progressively movable translating device individual to said switch and directly controlled over said incoming line to cause said switch to select a group of outgoing lines other than that indicated by the setting of said translating device, said automatic switch being directly controlled during its line selecting movement.

7. In a telephone system, an incoming line, a plurality of outgoing lines arranged in groups, an automatic switch operating through line and group selecting movements

to interconnect said incoming line with any of said outgoing lines, and a progressively operable translating switch individual to said automatic switch, said translating switch being directly controlled over said incoming line to take a desired setting, said automatic switch being controlled during its group selection by said translating device and caused to take a group setting other than that indicated by said translating device, said automatic switch being directly controlled during its line selecting movement.

8. In a telephone system, an incoming line, a plurality of outgoing lines, an automatic switch for interconnecting said incoming line with any of said outgoing lines, a progressively movable controlling switch individual to said automatic switch and operating circuits in multiple for said switches directly controlled over said incoming line.

9. In a telephone system, telephone lines, trunks for interconnecting said telephone lines terminating in numerical switches, a finder switch operating on the initiation of a call over any of said telephone lines to connect its trunk line to the calling line, a controller switch for maintaining said trunk normally open at points between its finder and numerical switch and means controlled over said incoming line for directly operating said controller switch to govern the setting of said numerical switch.

10. In a telephone exchange system, a selector switch having fixed terminals and moving contacts co-operating therewith, groups of lines connected to said terminals, other terminals being allotted for group selection, lines of said groups and said group selection terminals being interspersed in order of their appearance and means including a mechanical timing device associated with said selector switch for moving said contacts over said terminals to select an idle line.

11. In a telephone exchange system a selector switch having a terminal bank, groups of subscribers' lines connected to certain terminals of said bank, other terminals being allotted for group selection, directly controlled means for moving the switch over certain of said terminals and terminals of one of said groups, said means including a rotating timing device associated with said selector switch and means for automatically moving said switch over terminals in another group to select another group for a line selecting operation therein.

12. In a telephone exchange system, a selector switch having a terminal bank, groups of subscribers' lines connected to certain terminals of said banks, other terminals being allotted for group selection, directly controlled means for selecting one of said other terminals, said means including a mechani-

cal timing device associated with said selector switch and means for automatically moving the switch over certain line terminals in selecting the group of subscribers' lines associated with said other terminal.

13. In a telephone exchange system, a single movement switch, groups of subscribers' lines terminating in said switch, means for selecting a group decimally and automatically, and means for then selecting a line decimally, certain of said means including a mechanical timing device associated with said selector switch.

14. In a telephone exchange system, a switch having a movement in a single plane, a wiper for said switch, groups of subscribers' lines terminating in said switch, said subscribers' lines being decimally designated and means responsive to a number of impulses to step said wiper to select a group of lines and a line in said group, the steps of said wiper in its group and line selecting movements being of equal length, said means including a mechanical timing device associated with said selector switch and common to a plurality of said selector switches.

15. In a telephone system, a plurality of incoming lines, a trunk line; an automatic switch having movable brushes and contacts for interconnecting said trunk line with any incoming line over which a call is being extended; a line relay and a cut-off relay for each incoming line; sets of contacts for said relays controlled by the energization thereof; an operating circuit for said line relay extending on the initiation of a call over its incoming line through two sets of contacts of its associated cut-off relay over the two sides of an incoming line in series; a resistance, a battery and a double wound relay at said switch; an operating magnet for advancing said switch progressively; a circuit for said motor magnet extending from one side of said battery through said resistance, the winding of said motor magnet and contacts of said double wound relay to the opposite side of said mentioned battery; a circuit in multiple of that last described extending through one winding of said double wound relay, through a movable brush and contact of said automatic switch and contacts of said line relay to ground, said last mentioned circuit being effective to shunt the motor magnet to stop the operation of said switch and also being effective to energize said double-wound relay; and a holding circuit through the second winding of said double-wound relay for maintaining the connection completed.

16. In a telephone system, a plurality of incoming lines; a trunk line; an automatic switch for said trunk line for connecting the same with any of said incoming lines on the extension of a call thereover; a single-wound cut-off relay and a single-wound

line relay for each incoming line; sets of contacts for each of said relays; an energizing circuit for said line relay completed on the initiation of a call over one of said incoming lines, said circuit including the winding of said line relay, pairs of contacts of said cut-off relay and the two sides of said incoming line in series; a motor magnet for advancing said switch progressively to successively extend said trunk line to said incoming lines, a double wound relay associated with said trunk, said double wound relay having a set of contact springs arranged to be opened by the operation of said double wound relay; a source of battery; an energizing circuit for said motor magnet extending from one side of said source of battery through the winding of said motor magnet and through the contact springs of said double wound relay; an operating circuit including one winding of said double wound relay and including a portion of the operating circuit of the motor magnet; said last mentioned circuit being closed when said trunk line is extended to a calling incoming line to stop the operation of said motor magnet; a circuit for said cut-off relay completed through said switch when said trunk line is being connected to the calling line; and a holding circuit for maintaining the connection, completed through the second winding of said double wound relay.

17. In a telephone system, a plurality of incoming lines; a trunk line; an automatic switch for said trunk line for connecting the same with any of said incoming lines on the extension of a call thereto; a single wound cut-off relay and a single wound line relay for each incoming line; sets of contacts

for each of said relays; an energizing circuit for said line relay completed on the initiation of a call over its incoming lines, said circuit including the winding of said line relay, pairs of contacts of said cut-off relay and the two sides of said incoming line in series; a motor magnet for advancing said switch progressively to successively extend said trunk line to said incoming lines; a double wound relay associated with said trunk, said double wound relay having a set of contact springs arranged to be opened by the operation of said double wound relay; a battery, an energizing circuit for said motor magnet extending from one side of said source of battery through the winding of said motor magnet and through the normally closed contact springs of said double wound relay; an operating circuit for said double wound relay including one winding of said double wound relay, and including a portion of the operating circuit of the motor magnet, said last mentioned circuit being completed at normally open contacts of said line relay, said last mentioned circuit being closed when said trunk line is extended to a calling incoming line to stop the operation of said motor magnet; a circuit for said cut-off relay completed through said primary switch when said trunk line is being connected to the calling line; and a holding circuit for maintaining the connection, completed through the second winding of said double wound relay.

In witness whereof, I hereunto subscribe my name this 24th day of October, A. D. 1919.

WINFRED T. POWELL.