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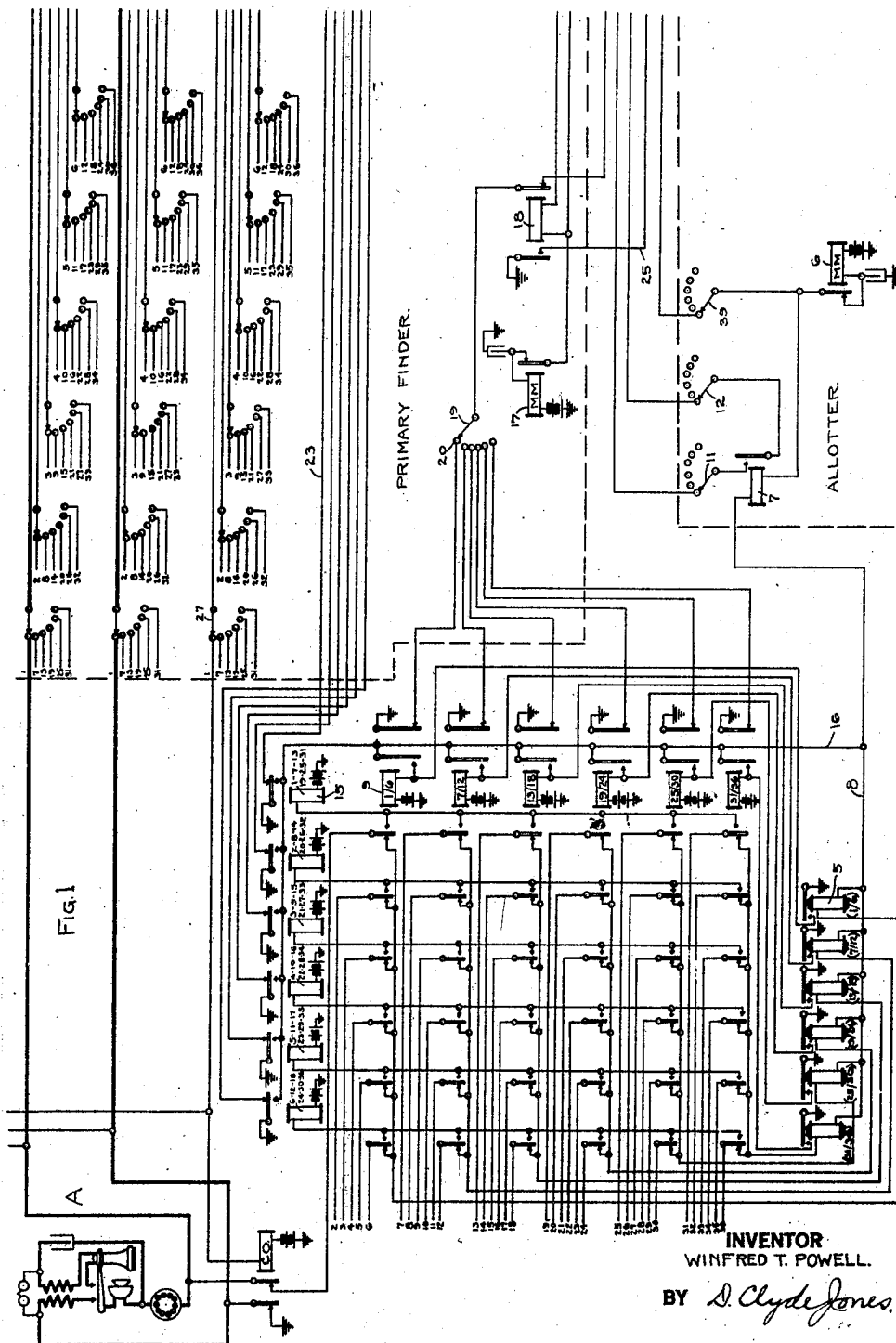
W. T. POWELL

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AUTOMATIC TELEPHONE SYSTEM

Filed Sept. 13, 1919

2 Sheets-Sheet 1



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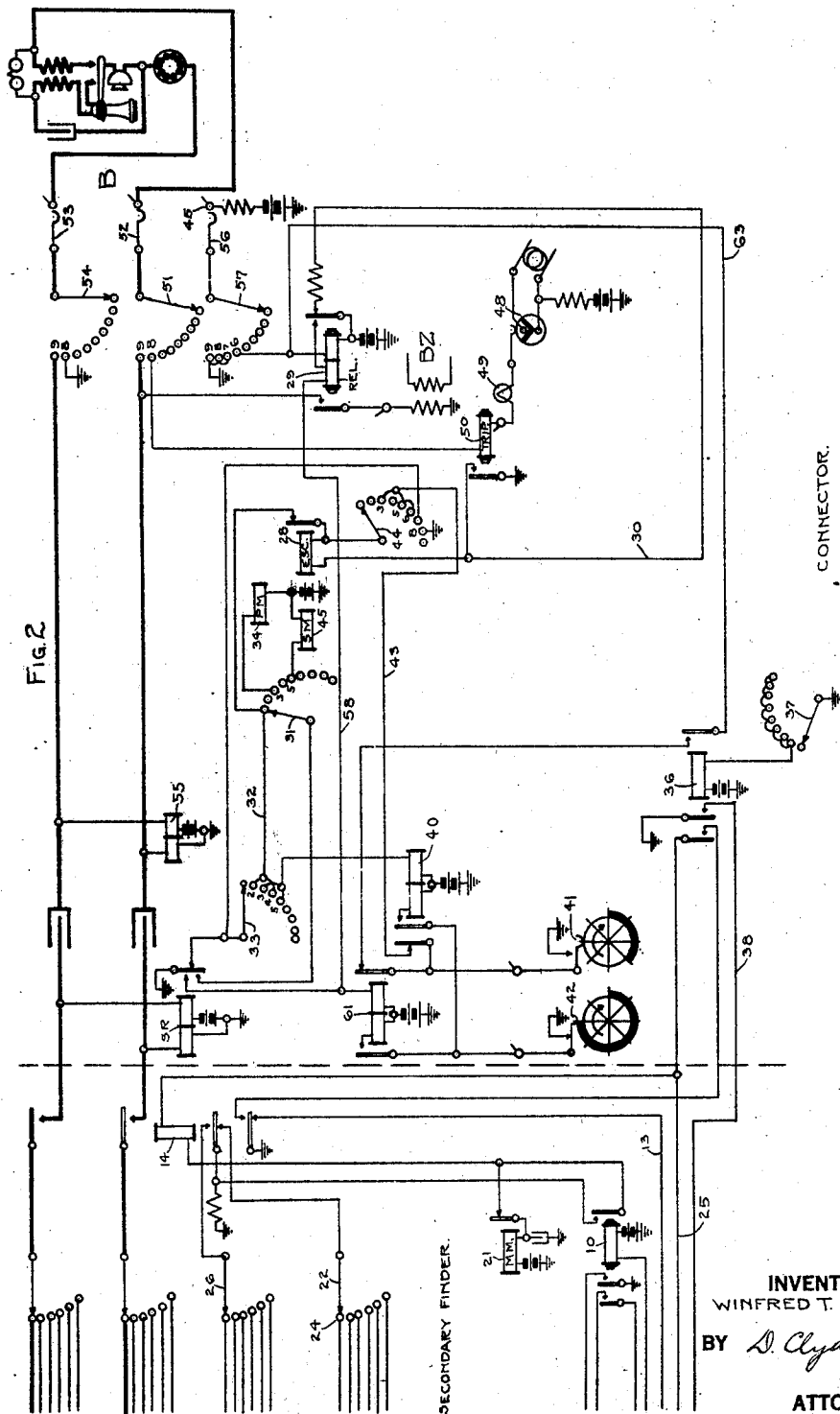
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2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

Application filed September 13, 1919. Serial No. 323,581.

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.

The present invention relates to telephone systems, and more particularly to telephone systems in which automatic switches are employed in establishing connections between telephone lines.

It is the purpose of the present invention to provide novel means including primary and secondary finder switches for establishing a connection between an allotted trunk and a calling line.

Improved circuits are also provided for controlling the operation of the numerical switches.

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

The drawings of Fig. 1 placed at the left of Fig. 2 diagrammatically represent a portion of a telephone system in which a group of relays co-operate in the control of primary and secondary finder switches to extend the calling line to an idle numerical switch, herein represented as a connector switch.

According to one embodiment of the invention, the telephone lines have been arranged in groups of thirty-six lines each, and for each such group of lines a group of six trunks is provided. These trunks are allotted for use in succession under the control of a stepping switch, herein designated as an allotter. Each trunk line terminates at one end in a numerical switch and at its other end in a hunting switch, herein designated a secondary finder. This finder operates to select one of several sets of brushes of a multi-brush line finder switch in the fixed contacts of which all the calling lines of a group terminate. Each of the lines is provided with a well known cut-off relay, but instead of a line relay individual to each line a group of relays common to the group of lines is provided which is less in number than the number of line relays formerly employed. This group of relays that has re-

placed the line relays is arranged in three sub-groups, the first sub-group operating to determine the stopping point of the primary finder switch; the second sub-group of relays operating to determine the stopping point of the secondary finder switch, while the third sub-group of relays co-operate in the control of the primary sub-groups of relays.

The small numerals adjacent the conductors representing the various telephone lines are an arbitrary numbering of these lines, while similar numerals associated with the various relays of the sub-groups indicate that these relays co-operate in the extension of calling lines. In the case of one sub-group of relays, the following arrangement of numerals appears as 1/6, 7/12, etc., which indicates that these relays are common to the lines 1 to 6 inclusive, and 7 to 12 inclusive.

The primary and secondary finder switches as well as the allotter may be of the uni-directional rotary type which are substantially similar in structure to the switch disclosed in the patent to E. E. Clement, No. 1,107,153. These switches have no normal position, but remain in engagement with the contacts last used.

The connector switch employed in this system may be substantially similar in structure so that disclosed in the patent to Keith, et al. No. 815,176, patent March 15, 1906, when modified to operate in the well known two wire system.

A timing device is diagrammatically shown in Fig. 2 of the drawings. This device may be of the form in which circuits closed at brushes 41 and 42 are completed during predetermined time intervals. As shown, this timing device may take the form of a constantly rotating shaft provided with several cams. These cams are cut in such a way as indicated by the portion thereof representing insulation, so that a circuit is always closed through brush 41 whenever a circuit is closed through brush 42.

It is believed that the present invention will best be understood by describing the method of establishing a connection from a calling substation designated "A" to the called sub-station indicated at "B."

Let it be assumed that the primary and

secondary finders are standing in some position other than that in which they are shown in Figs. 1 and 2 when the calling subscriber at "A" removes his receiver from its switch-hook. At this time the relay 5 is operated in a circuit closed from grounded battery, winding, back contact and armature of the motor magnet 6 of the allotter, winding of the relay 7, conductor 8, winding of the relay 5, inner-most back contact and armature of relay 9 of the secondary sub-group of relays, inner back contact and armature of the cut-off relay CO of the calling line, through the calling substation circuits, armature and back contact of the cut-off relay to ground. The relays 5 and 7 are energized in this circuit, but the motor magnet 6 remains inactive. The relay 7 when actuated closes a circuit for the slow-releasing relay 10 from grounded battery, winding of this relay, allotter brush 11, front contact and armature of relay 7, allotter brush 12, conductor 13, lower-most back contact and armature of the switching relay 14 to ground. At the upper armature and front contact of relay 5 a circuit is closed from ground, winding of relay 9 to grounded battery. The relay 9 is actuated in this circuit and at its inner-most front contact and armature closes a circuit for the relay 15 of the secondary sub-group of the controlling relay from grounded battery, winding of relay 15, front contact and armature of relay 9, back contact and armature of the cut-off relay CO, through the substation circuit to ground at the outer armature and back contact of the cut-off relay. The relay 15 attracts its armature and completes a locking circuit from ground, its armature and front contact, armature and front contact of relay 9, and winding of relay 9 to grounded battery. Under the control of this circuit the relay 9 is maintained actuated, at the same time the relay 7 associated with the allotter is maintained operated over conductor 16, to ground at the front contact and armature of the relay 15. It will thus be seen that the relay 15 holds the relays 9 and 7 actuated until the cut-off relay is operated, which indicates that the primary and secondary finder switches have completed their operation. Relay 15 also applies ground to conductor 16 so that none of the relays of the sub-groups to which relay 5 belongs can be operated, thus preventing a second call from the same group of lines interfering with the first call.

As soon as the relay 10 is operated, the primary finder and secondary finder switches simultaneously begin to operate. The primary finder is advanced under the control of the motor magnet 17 in a circuit traceable from grounded battery, winding, back contact and armature of this magnet, outer front contact and armature of the relay 10, right hand back contact and armature of relay 18, primary finder test brush 19 to ground at the outer-most right hand back contacts and armatures of the primary sub-group of relays. Under the control of this circuit the motor magnet 17 advances the brushes of the primary finder switch until its test brush 19 engages the test contact 20 on which there is no ground potential owing to the fact that the relay 9 is operated at this time. When this condition exists, the relay 18, which has previously been short-circuited by ground applied over test brush 19, the outer left hand front contact and armature of relay 10, is now operated in a circuit closed from grounded battery, winding, back contact and armature of the motor magnet 17 of the primary finder switch, winding of the relay 18, inner-most front contact and armature of relay 10 to ground. At the left hand armature and front contact of relay 18 a break point of the operating circuit of the switching relay 14 is closed.

When the relay 10 is actuated and simultaneously with the operation of the primary finder switch, the secondary finder switch is advanced under the control of a circuit traceable from grounded battery, winding, armature and back contact of the motor magnet 21 of the secondary finder switch, right hand armature and front contact of relay 10, inner-lower armature and back contact of relay 14, secondary finder switch test brush 22, test conductors similar to conductor 23 to ground at the armatures and back contacts of the secondary sub-group of relays. When, however, the secondary finder test brush engages the test contact 24 on which there is no ground potential due to the operation of relay 15, the secondary finder switch is stopped. When both the primary and secondary finder switches have completed their operations, the switching relay 14 is operated in a circuit closed from grounded battery, winding, armature and back contact of the motor magnet 21, winding of the relay 14, conductor 25, left hand front contact and armature of relay 18 to ground.

When the relay 14 attracts its armatures, the calling line is extended over the selected trunk to the stepping relay SR of the numerical switch, in the present disclosure a connector switch. At the inner armature and front contact of relay 14 a circuit is closed from ground, resistance, secondary finder brush 26, primary finder brush 27, winding of the cut-off relay CO of the calling line to grounded battery. The cut-off relay operates to deenergize the relay 15, and this in turn causes the deenergization of the relays 7 and 9.

Since the calling line is linked to an idle

connector switch, it only remains to transmit impulses corresponding to the tens and units digits of the wanted number. In connection with the operation of the connector switch it will be noted that the stepping circuits for the primary and secondary motor magnets of the connector are controlled at the front contact of the stepping relay SR, and the relays employed to control the "change-over" from the primary to the secondary operation of the switch are not slow in operation, but may be of the fast operating type since they are controlled by a timing device, common to the exchange. It should be noted that the escape magnet which moves the side switch wipers on deenergization, is not energized during the transmission of impulses. Since the stepping relay SR is energized as soon as the connector switch is seized, the escape magnet 28 is energized in a circuit completed from grounded battery, right hand armature and back contact of the release magnet 29, resistance, conductor 30, winding, armature and back contact of the escape magnet 28, side switch wiper 31 in its first position, front contact and armature of the stepping relay SR to ground. The escape magnet 28 interrupts its own circuit in this instance and advances the side switch wipers into their second position.

When the side switch is moved from position one and until it is restored to this position, the relay 36 is maintained energized over a circuit closed at the side switch wiper 37. The relay 36 is thus energized and at its right hand armature and contact closes a break point in the release circuit of the connector switch. At the inner left hand armature and front contact of this relay ground is applied to conductor 38, indicating a busy condition of the trunk to which it is individual, and thus causes the motor magnet 6 of the allotter to be energized over brush 39 to move the allotter into a position to assign the next idle trunk for use. At the outer left hand armature of the relay 36 a locking circuit is closed for the switching relay 14 which may be traced from grounded battery, winding, armature and back contact of the motor magnet 21, switching relay 14, outer armature and front contact of relay 36, lowermost front contact and armature of relay 14 to ground. When the stepping relay SR retracts its armature on the opening of the impulse contacts of the dial sender preparatory to receiving the first current impulse, a circuit is closed from ground, armature and back contact of the stepping relay SR, side switch wiper 33 in its second position, conductor 32, back contact, armature and winding of the escape magnet 28, conductor 30, resistance, right hand back contact and armature of the release magnet 29 to ground-

ed battery. The escape magnet again interrupts its own circuit and advances the side switch wipers into their third position in which position the connector switch is in readiness to receive the impulses from the substation sender, or dial. As the dial sender continues to operate and to transmit impulses corresponding to the tens digit of the wanted number, the primary motor magnet 34 is operated once for each impulse received from the dial sender under the control of a circuit closed from grounded battery, primary motor magnet 34, side switch wiper 31 in its third position, and right hand front contact and armature of the stepping relay SR to ground. As soon as the stepping relay SR retracts its armature, a circuit is closed from ground, through side switch wiper 33 in its third position, right hand winding of relay 40 to grounded battery. When, however, the relay SR attracts its armature in response to the next impulse of current, this energizing circuit for the relay 40 is opened, but whenever the circuit for the escape magnet 28 is completed at brush 41 during the transmission of any series of impulses, it will be opened at the outer left hand armature and back contact of relay 40, since at this time this relay will be held operated in a circuit closed from grounded battery, through its left hand winding, armature and front contact, and brush 42 of the interrupter to ground. At the close of the tens series of impulses, the relay SR will attract its armature for a relatively long interval, thus opening the initial energizing winding of the relay 40 and sufficient time will elapse for the timing device to be rotated so that its brush 42 will disengage its grounded contact. Relay 40 will thus be deenergized until the units series of impulses is transmitted to the connector switch, and when in the course of the next revolution of the timing device brush 41 engages its grounded contact, a circuit will be closed for the escape magnet through the outer left hand armature and back contact of relay 40, conductor 43, side switch wiper 44 in its third position, winding of the escape magnet 28, conductor 30, resistance, right hand back contact and armature of the release magnet 29 to grounded battery. The escape magnet 28 is energized in the circuit just described, but when the interrupter in the course of its operation permits the brush 41 to disengage its grounded contact, the escape magnet 28 deenergizes and moves the side switch wipers into their fourth position.

When now the stepping relay SR deenergizes preparatory to receiving the first impulse of the series corresponding to the units digit of the wanted number, the escape magnet 28 is energized in a circuit now extending from grounded battery, right hand

armature and back contact of the release magnet 29, resistance, conductor 30, winding of the escape magnet 28, its armature and back contact, conductor 32, side switch wiper 33 in its fourth position, and back contact and armature of the stepping relay SR to ground. When the stepping relay again attracts its armature in response to the first impulse of this series, this circuit of the escape magnet is interrupted and it moves the side switch wipers into their fifth position. In response to each impulse corresponding to the units digit of the wanted number, the stepping relay SR vibrates its armature and closes a circuit from ground, its armature and front contact, side switch wiper 31 in its fifth position, secondary motor magnet 45 of the connector to grounded battery. The escape magnet 28 remains inactive during the series of impulses corresponding to the units digit of the wanted number as in the case of the preceding series of impulses, but at the close of the units impulses the escape magnet 28 is energized over a circuit closed through side switch wiper 44 in its fifth position, conductor 43 to ground at brush 41 of the interrupter, and the side switch wipers are moved into their sixth position. In this position the called line is tested and if idle, there will be no ground potential on its multiple test terminal, such as 45, so that the escape magnet 28 will again be energized and deenergized in a circuit closed over side switch wiper 44 in its sixth position, conductor 43, brush 41 of the timing device so that the escape magnet moves its wipers into their seventh position.

The present system has been designed so that ringing current is not applied when the called line is found to be idle, but it is necessary to operate the dial sender to transmit at least one additional impulse. It will be understood, however, that the present invention may be employed in a system in which ringing current is transmitted to the called line as soon as this line is found to be idle without any additional operation of the dial sender.

In response to the last mentioned impulse or series of impulses, the stepping relay retracts its armature and again closes a circuit from ground, through the armature and back contact of the stepping relay, side switch wiper 44 in its seventh position, escape magnet 28 to grounded battery at the armature of the release magnet, over conductor 30. When the stepping relay SR again attracts its armature, it interrupts the operating circuit of the escape magnet, causing this magnet to move the side switch wipers into their eighth, or ringing position. In this position ringing current is applied to the called line over a circuit extending from grounded battery, resistance, through

the ringing machine generally designated 48, lamp 49, marginal ringing trip relay 50, side switch wiper 51 in its eighth position, connector brush 52, through the bell at the called substation, connector brush 53, and side switch wiper 54 in its eighth position to ground. At the same time a circuit is closed for energizing the escape magnet 28 from grounded battery, right hand armature and back contact of the release magnet 29, resistance, conductor 30, winding of the escape magnet, and side switch wiper 44 in its eighth position to ground. The trip relay 50 as is well known, does not operate until the called subscriber removes his receiver whereupon it attracts its armature and short-circuits the escape magnet, causing this magnet to move the side switch wipers into their ninth position. Talking battery for the calling party is applied through the windings of the stepping relay SR, and talking battery for the called party is applied through the windings of the impedance coils 55.

In the event that the called line is busy when the test brush 56 of the connector engages its test terminal 45, a ground potential will be present on this test terminal, and since the side switch wipers are in position six, this ground will be applied over the side switch wiper 57, right hand winding of the release magnet to grounded battery. The release magnet attracts its armatures and at its left hand armature and front contact applies a busy tone from the busy machine BZ to the calling line, and at its right hand armature and front contact a locking circuit is closed through the left hand winding of the release magnet 29, conductor 58, and front contact and armature of the stepping relay SR. The release magnet restores the connector switch and the side switch to normal position, and when this position is reached the relay 36 which has been held energized as long as the side switch was out of position one, releases. At the inner left hand armature and front contact of relay 36, the guarding potential for the trunk in use is removed from conductor 38, which permits the allotter to seize this trunk in due course and at the outer left hand armature of relay 36 the locking circuit of the switching relay 14 which controls the break point in the trunk conductors leading to the connector switch deenergizes, and also opens the holding circuit of the cut-off relay CO.

When the calling party terminates the call by replacing his receiver on the switch-hook, the connector switch is released in the same manner as in the case when the called line is busy except that in this instance the release magnet is initially energized in a circuit controlled at the right hand back contact and armature of the relay 61. This

relay 61 it will be remembered is held energized during conversation by a circuit extending through its right hand winding to ground at the front contact and armature of the stepping relay SR, or by a locking circuit through its left hand winding completed through brush 42 when the release current would otherwise be completed at interrupter brush 41. When the calling subscriber replaces the receiver on the switchhook, the stepping relay SR retracts its armature and opens the circuit through the right hand winding of relay 61. This relay may be held energized for a short time in a circuit now extending from grounded battery, its left hand winding, front contact and armature and interrupter 42 to ground. However, when the brush 42 disengages its spring contact, this circuit is opened and the relay 61 deenergizes. The release magnet 29 is thereupon operated in a circuit traceable from grounded battery, its right hand winding, conductor 63, right hand armature and front contact of relay 36, back contact and armature of relay 61, interrupter brush 41 and its contact to ground. The release of the connector and the other apparatus employed in establishing the call are thereupon effected as in the case of a busy called line.

What I claim is:

1. In a telephone system, a plurality of telephone lines, trunks, a plurality of groups of relays arranged to be variably operated during the initiation of a call, said relays being less in number than the number of said lines, and primary and secondary progressively movable finder switches operating simultaneously under the control of said groups of relays for connecting an idle trunk to the calling line.

2. In a telephone system, groups of telephone lines, trunks for extending said telephone lines, groups of relays associated with each group of telephone lines and each relay being common to a portion only of said lines of a group, and primary and secondary progressively movable switching means operating under the control of said groups of relays for connecting an idle trunk to the calling line.

3. In a telephone system, a group of telephone lines, trunks for extending any of said lines, a plurality of relays individual to said group and arranged in sub-groups, one sub-group of relays being common to certain of said telephone lines, a second sub-group of relays common to certain other lines, primary and secondary progressively movable switching means jointly controlled by the operation of said switching relays to extend one of said telephone lines when calling to one of said trunk lines.

4. In a telephone system, an incoming line, a plurality of outgoing lines, an auto-

matic switch operating through primary and secondary movements for extending said incoming line to a desired outgoing line, a relay having an armature and contacts controlled thereby, said relay being directly controlled over said incoming line from a distant point, a primary magnet for advancing said switch in its primary movement, and a secondary magnet for advancing said switch in its secondary movement to connect said incoming line to a desired outgoing line, circuits for said primary and secondary magnets completed at front contacts of said relay, a sequence controlling device for determining the sequence of operation of said primary and secondary magnets, means common to a plurality of lines for governing said sequence controlling device, and a release mechanism for releasing said automatic switch.

5. In an automatic telephone system, a plurality of telephone lines arranged in groups, a plurality of trunks, a group of relays for each group of lines, each of said relays being common to a plurality of lines, an operating circuit passing through each of said relays including the two sides of any one of a plurality of said lines in series when calling, non-numerical switches for extending a calling line to an idle trunk, other relays associated with each group of lines, and means including said first and said last mentioned relays for controlling the operation of said switches.

6. In an automatic telephone system, a plurality of telephone lines arranged in groups, a plurality of trunks, a plurality of relays for each group of lines, each of said relays being common to a plurality of lines, an operating circuit passing through each of said relays including the two sides of any one of a plurality of said lines in series when calling, a second group of relays associated with each group of lines and a circuit for each of said relays including the two sides of any one of a plurality of lines when calling, non-numerical switches for extending a calling line to an idle trunk, and means including relays of each of said groups for controlling the operation of said switches.

7. In an automatic telephone system, a plurality of telephone lines arranged in groups, a group of trunk circuits accessible to said group of telephone lines, two groups of relays associated with said group of lines, said relays being provided with energizing circuits including a portion of each of the two sides of the calling line in series and means including a pair of said relays for controlling the operation of said automatic switching means.

8. In an automatic telephone system, a plurality of telephone lines arranged in groups, groups of trunk circuits, primary and secondary non-numerical switches for

interconnecting calling lines and idle trunks, a primary group of relays common to each group of telephone lines, each relay of a group having an energizing circuit including the two sides in series of any one of a plurality of telephone lines, a second group of relays common to said last mentioned group of lines arranged to be variably operated by the operation of one of the relays of said primary group, a third group of relays each of which is common to a group of telephone lines, an energizing circuit for each relay of the third group controlled by some relay of said second group, each last mentioned circuit including the two sides in series of any one of a plurality of telephone lines, means for advancing said primary and secondary switches on the initiation of a call, and means including said second and said third groups of relays for stopping the primary and secondary non-numerical switches in position to extend the calling line to an idle trunk.

10 of said primary group, a third group of relays each of which is common to a group of telephone lines, an energizing circuit for each relay of the third group controlled by some relay of said second group, each last

15 series of any one of a plurality of telephone lines, means for advancing said primary and secondary switches on the initiation of a call, and means including said second and said third groups of relays for stopping the primary and secondary non-numerical switches in position to extend the calling line to an idle trunk.

20 In witness whereof, I hereunto subscribe my name this 11th day of September A. D. 1919.

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WINFRED T. POWELL.