

**June 30, 1925.**

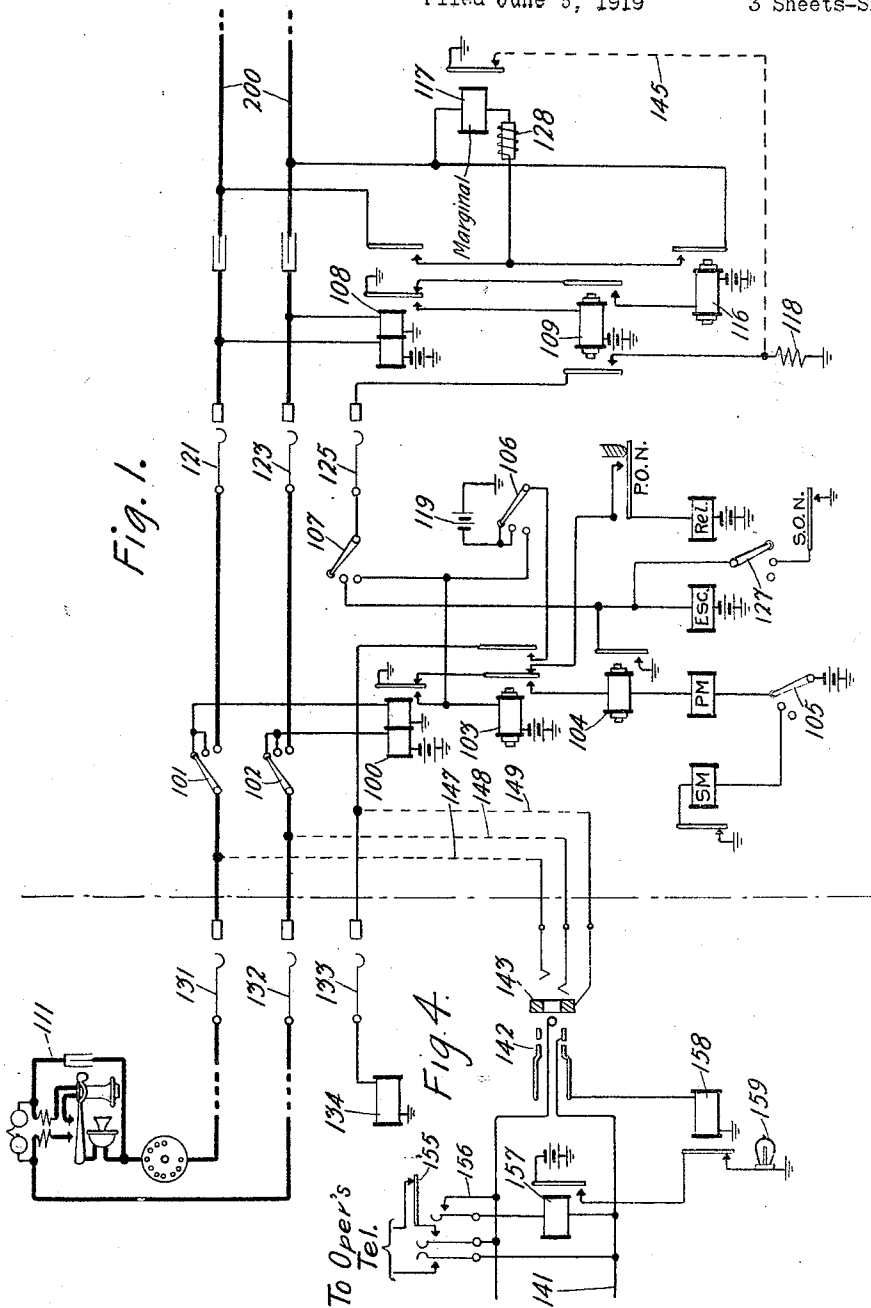
L. POLINKOWSKY

1,543,869

TELEPHONE EXCHANGE SYSTEM

Filed June 5, 1919

3 Sheets-Sheet 1



Inventor:  
Lipa Polinkowsky  
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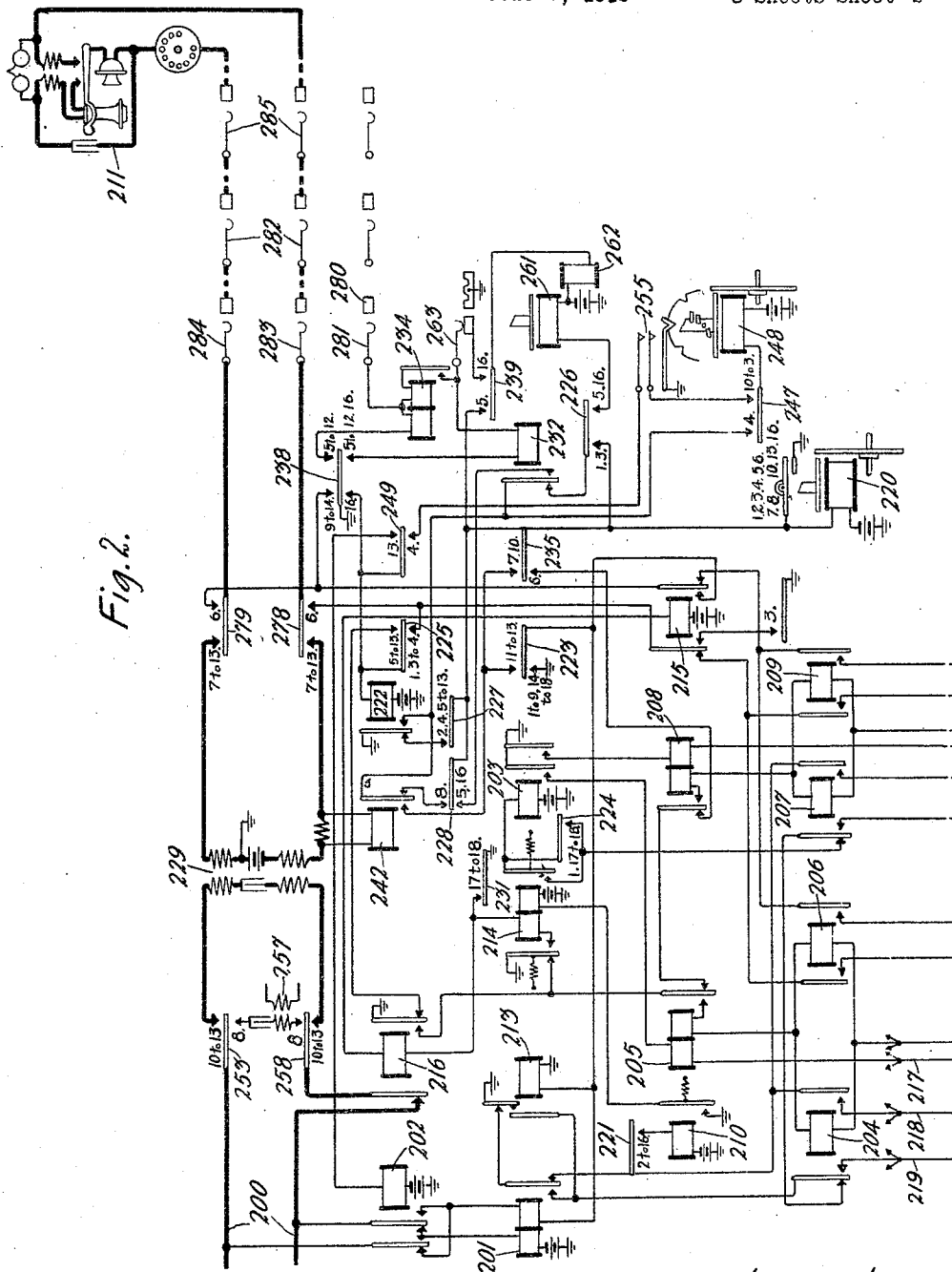
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3 Sheets-Sheet 2



Inventor:  
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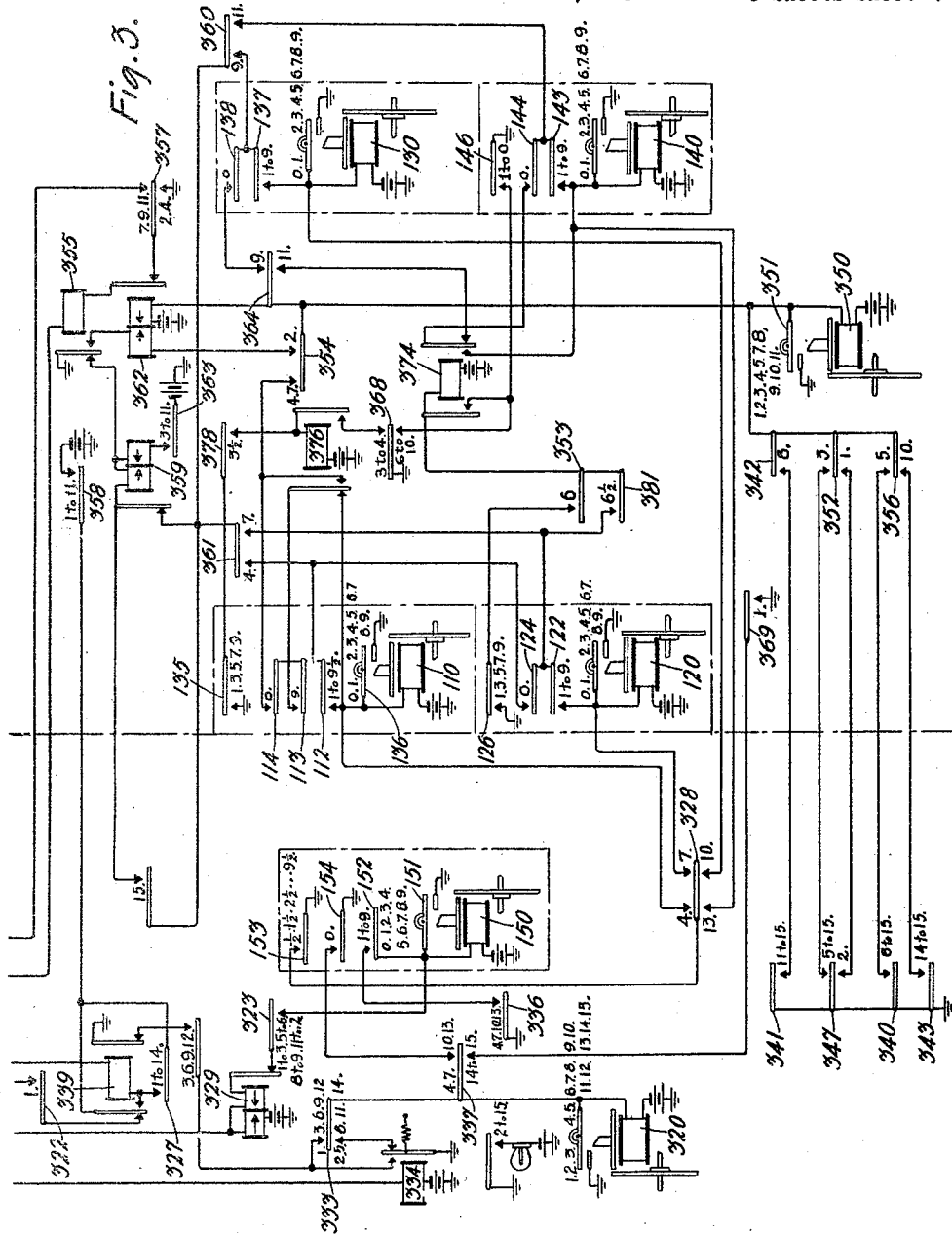
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TELEPHONE EXCHANGE SYSTEM

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3 Sheets-Sheet 3



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## UNITED STATES PATENT OFFICE.

LIPA POLINKOWSKY, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

## TELEPHONE-EXCHANGE SYSTEM.

Application filed June 5, 1919. Serial No. 301,933.

*To all whom it may concern:*

Be it known that I, LIPA POLINKOWSKY, a citizen of Russia, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems employing automatic switching apparatus for establishing talking connections between subscribers' lines. More particularly it has to do with a telephone system involving a plurality of exchanges, and in which facilities are provided for the establishment of talking connections between subscribers' lines belonging to an exchange equipped with switches of one character and subscribers' line belonging to exchanges equipped with switches of a different character.

An object of the invention is the provision, in a system of the foregoing character, of means whereby a subscriber's line at an exchange utilizing step-by-step operated switches may be extended directly over such switches to a distant exchange provided with power driven switches, together with means for controlling the selective operation of such power driven switches for further extending said line into connection with a called line at the second exchange.

A feature of the invention relates to an arrangement in which a calling subscriber is enabled to directly operate step-by-step switches to extend his line, and thereafter to cause the setting of a controlling mechanism, which in turn becomes effective to control the selective operation of other switches to further extend said line.

A further feature consists in the provision of means for operating selective switches in accordance with certain digits of a desired number and for setting a switch controlling mechanism in accordance with the complements of other digits of said number for the purpose of extending a telephone connection to the called line.

A still further feature consists in providing means, in a system where a controlling mechanism for controlling selective switches is normally selectable when said switches are in their restored position, for rendering such controlling mechanism selectable prior to the restoration of said switches.

Such other and further features as are contemplated by the present invention will become apparent from the following description and the appended claims.

In the drawings Fig. 1 shows a calling subscriber's line terminating in a non-numerical switch at the exchange, a selector switch of the step-by-step type and the circuits of an impulse repeater.

Fig. 2 shows in detail, the circuits, of a first group selector of the power driven type, located at a distant exchange and associated with the incoming end of a trunk line from the exchange illustrated in Fig. 1, together with the diagrammatic showing of succeeding power-driven selector switches.

Fig. 3 shows in detail, a register controlling equipment and its associated circuits for controlling the selective operation of the power-driven switches, and also means for positioning said registers in accordance with a desired designation.

Fig. 4 shows a portion of the equipment at an operator's position in the step-by-step office including the calling end of one of the cord circuits. An illustration is also given of the manner in which the trunk circuits at the operator's position are connected to the conductors leading to a first selector switch, such as shown in Fig. 1.

In accordance with the general principles of this invention, there is provided a telephone system in which it is possible to accomplish joint working between exchanges equipped with switching mechanism of the step-by-step character, and exchanges equipped with switching mechanism of the power-driven type. When a subscriber to an exchange of the step-by-step character desires to hold conversation with a subscriber whose line belongs to an exchange provided with power driven switches, he manipulates his calling transmitter in the usual manner to send series of impulses corresponding to the digits of the desired number. Depending upon the relative capacities of the two exchanges involved, a part of these impulse series are effective to set up the step-by-step switches in the exchange to which the calling line belongs to extend the connection over an interconnecting trunk line to the desired distant exchange. Thereafter the remaining impulse series of the called number operate to position the registers of an idle controlling mechanism.

These registers, when thus positioned, become effective to control the selective movements of switches in the called exchange which are operated by power in a continuous movement to complete the establishment of the connection to the called line.

In systems where step-by-step switches are used, it is the general practice to arrange the selective switches for operation in accordance with the digits of the called number. That is to say, the first selector, for example, is directly operative through a number of steps corresponding to the first digit of a desired number as listed in the telephone directory. Consequently, the calling dials at the substation are designed to transmit impulses in correspondence with the digits of the line designations listed in the directory. However, in power-drive exchanges of the character disclosed in the present system, the switch controlling registers are arranged to control the selective switches in accordance with the complements of the digits transmitted from the substations. The use of such a register controlling equipment makes it necessary for the calling transmitters at the substations of lines belonging to the exchange to be designed to transmit to the exchange series of impulses which correspond to the complements of the digits of called line numbers.

It becomes obvious that since the calling transmitters of lines belonging to the step-by-step exchange are arranged to send impulses in the regular way, each series containing a number of impulses corresponding to the desired digits, whereas the controlling registers in the power drive-exchange are designed to receive impulses according to the complements of the desired digits, means must be provided where a call is extended from a step-by-step exchange to a power-drive exchange, to make correction for such of the impulse series of the called number as are to be effective in controlling the power driven switches. To this end there is provided at the power drive exchange means for receiving the series of impulses incoming from the distant exchange of the step-by-step type, and which is operative to control the positioning of the successive switch controlling registers in accordance with the complements of the number of impulses in each series. By such an expedient, the registers are set up to positions where they are effective to subsequently control the selective switches according to the digits of a called number, the same as if they had been positioned under the control of a transmitter at the substation of a line belonging to the power-drive exchange.

Referring to Fig. 1, wherein a calling subscriber's line to an exchange is extended over line or finder switches and selector switches

to the desired called line, there is also shown a modification providing for the use of operators in the establishment of connections. Considering the system as one of the full automatic type, the operator's cord circuit shown in Fig. 4, may be disregarded, whereas in considering it as a semi-automatic system, it will be understood that connections with calling lines are made in the well known manner by the insertion of the answering end of the operator's cord circuits, not shown in the disclosure. In this case, the necessary alterations in the circuits shown in Fig. 1 are illustrated by the dotted line.

The switches in the second office may be of the construction shown and described in the patent to McBerty, No. 1,097,868, granted May 26, 1914. The general manner in which switches of this type are controlled is described in the patent to Polinkowsky, No. 1,365,269, granted January 11, 1921.

It will first be assumed that the subscriber to a line, such as line 111, of the step-by-step exchange, wishes to converse with the subscriber of line 211 belonging to an exchange equipped with power-driven switches. On removing his receiver to initiate the call, the brushes 131, 132, 133 of the line switch are automatically connected to the terminals of a trunk leading to an idle first selector switch. A circuit is then completed from battery through the left hand winding of line relay 100 of the selector switch, side switch arm 102 (position 1), brush 132, over the loop of the calling line, brush 131, side-switch arm 101 (position 1), right hand winding of relay 100 to ground. Relay 100 attracts its armature and closes a circuit from battery, through the winding of slow-to-release relay 103, to ground at the front contact and armature of relay 100. Relay 103 completes a circuit from ground, battery 119, side switch arm 106 (position 1), contact and outer armature of relay 103, test brush 133, through the winding of magnet 134 to ground. The magnet 134 serves to maintain the connection of the line switch in any well known manner. The calling subscriber operating his dial for the first digit causes the line relay 100 to intermittently release and attract its armature. On the first release of the armature of said relay, a circuit is closed from ground, armature and back contact of relay 100, inner armature and front contact of relay 103, through the winding of the second slow-to-release relay 104, winding of the primary stepping magnet PM, side switch arm 105, (position 1) to battery and ground. The primary magnet PM operates to advance the brushes 121, 123 and 125 one step. Relay 104 completes a circuit at its armature and contact for the energization of the escape magnet ESC. At each succeeding inter-

ruption of the calling line, magnet PM advances brushes 121, 123 and 125 through one step bringing them in operative relation to the desired group of trunks. Relays 103 and 104 being slow-to-release maintain their armatures attracted during the short interruptions of their energizing circuits. When the last impulse has been sent and the line relay 100 maintains its armature attracted for a sufficient period, the slow-to-release relay 104 retracts its armature and the escape magnet deenergizes to advance the side switch into position 2.

In position 2 of the side switch, a circuit is established from battery, side switch arm 105 (position 2), through the winding of the secondary stepping magnet SM, the armature and contact of said magnet to ground. The stepping magnet SM interrupts its own circuit and operates to advance the brushes 121, 123 and 125 over the successive terminals in the selected group. When the side switch moves into position 2, the escape magnet ESC is energized in a circuit including side switch arm 127 (position 2) and the secondary off-normal contact SON. As the selector switch is moved through its first step, contact SON is opened and the escape magnet depends thereafter for its energization upon a circuit including side switch arm 107, and the test brush 125. If the trunk individual to the first set of terminals in the selected group is busy, relay 109 of the repeater will be energized and the escape magnet ESC remains energized in a circuit to ground over the left-hand armature and contact of relay 109 and resistance 118. The secondary magnet SM therefore continues to operate until test brush 125 reaches a non-grounded terminal, whereupon the escape magnet deenergizes and moves the side switch into position 3.

In this position a circuit is completed from battery through the left hand winding of relay 108 of the repeater, brush 121, side switch arm 101 (position 3), brush 131, over the loop of the calling substation, brush 132, side switch arm 102 (position 3), brush 123, right hand winding of relay 108 to ground. Relay 108, energizing, closes a circuit for slow-to-release relay 109, which by attracting its armature places a ground on the multiple test terminals to ender the selected trunk busy. In passing out of position 2, the side switch arms 101 and 102 open the circuit of relay 100, which in turn, opens the original energizing circuit of the slow-to-release relay 103. Before relay 103 can deenergize, however, a new circuit is completed therefor from battery through the winding of relay 103, side-switch arm 107 (position 3), brush 125, left hand armature and contact of relay 109 to ground through the resistance 118. In position 3 of the side

switch, magnet 134 of the line switch is maintained energized in a circuit from battery through the winding of relay 103, side-switch arm 106 (position 3), contact and outer armature of relay 103, brush 133 through the winding of magnet 134 to ground. The resistance of magnet 134 and relay 103 are so adjusted with respect to resistance 118 that magnet 134 will remain energized in the circuit just traced, but relay 103 will not receive sufficient current to remain energized in series with magnet 134.

While in the disclosure only one step-by-step selector switch is shown, it is to be understood that any number of such switches might be included between the primary switch and the repeater at the outgoing end of the trunk 200.

When the line relay 108 of the repeater energizes, it closes at its outer armature a bridge across the outgoing end of the trunk line 200. Line relay 201 at the distant exchange is thereby energized in a circuit from battery through the left hand winding thereof, back contact and inner armature of relay 202, over the lower conductor of trunk 200 through the windings of relay 117 and impedance 128, contact and outer armature of relay 108 upper conductor of trunk 200, back contact and outer armature of relay 202, right hand winding of relay 201, contact 223 (1) of sequence switch 220 to ground. Relay 201 closes a circuit from ground, normal contact of relay 213, armature and front contact of relay 201, left hand armature and back contact of relay 204, left hand armature and back contact of relay 207, contact 224 (1) winding of relay 203 to battery and ground. Relay 203 prepares circuits for relays 205 and 208. These relays are each individual to two register controlling mechanisms, the relay 205 serving to associate the register to which it is individual with the cord circuit when such register is idle, and the relay 208 serving to associate the register to which it belongs when the first register is busy. Assuming the register mechanism shown in detail in Fig. 3 which is the one controlled by relay 205, is idle at this time, a circuit is closed from ground, inner armature and contact of relay 203, through the left hand winding of relay 205, conductor 217, contact 322 (1) of sequence switch 320, back contact and left hand armature of relay 339, contact 358 of sequence switch 350 to battery. Relay 205 energizing closes a locking circuit for itself in series with relay 339 independent of the armature and contact of relay 203. This circuit may be traced from battery, contact 358 (1) armature and front contact of relay 339, through the winding of said relay, in parallel through the windings of relays 204 and 206, through the right-hand winding of relay 205, front contact and armature of said

relay to ground at back contact and left hand armature of relay 214. The relay 205 opens at its armature and back contact a similar locking circuit for the left-hand winding of the relay 208 individual to the second register controlling mechanism so that preference is given to the first controlling mechanism, shown in Fig. 3, when the same is idle. Relays 204 and 206 attract their armatures to associate the selected register controlling mechanism with the cord circuit of the first group selector preparatory to the receipt of impulses from the calling substation. Relay 204 by energizing also opens the above traced circuit for relay 203 which in turn releases its armatures. Relay 339 by attracting its left hand armature opens the circuit of conductor 217 to render the controlling mechanism non-selectable to other cord circuits. The preparation of the circuits thus described at the second exchange has taken place in a very short time after the selection of the trunk 200 by the last step-by-step selector switch in the calling exchange, so that the calling subscriber may continue to proceed uninterrupted with the operation of his dial to send the second, third, fourth and fifth digits of the called number. Since the last four series of impulses are operative to control the power-driven switches in the called exchange, and since as already explained the registers must be set up to a position complementary to the number of impulses contained in each of these successive series, there is provided a sequence switch 150 for this purpose, responsive to the impulses incoming from the calling exchange, and automatically associable in succession with the controlling registers 110, 120, 130 and 140.

The calling subscriber operating his dial to send the second digit causes the intermittent operation of line relay 108 at the repeater. On the first retraction of the armatures of relay 108, the slow-to-release relay 116 is energized in a circuit over the contact and right-hand armature of relay 109 to ground at the back contact and inner armature of the relay 108. The relay 116 closes a shunt around the windings of relay 117 and impedance 128 to remove said impedance from the impulse circuit during the time the calling subscriber is operating his dial. When relay 204 is energized, it closes a circuit from ground, normal contact of relay 213, armature and front contact of relay 201, left-hand armature and front contact of relay 204, conductor 219, through the winding of relay 334 to battery and ground. The relay 334 is constructed to attract its armature slowly. Relay 201, being energized long enough for this purpose, relay 334 energizes and closes a circuit from ground, over its armature and front contact, sequence switch contact 333 (1) through the

winding of sequence switch 320 to battery, to drive sequence switch 320 out of position 1 into position 2. At the first deenergization of relay 108, relay 201 releases its armature and closes a circuit from ground, normal contact of relay 213, armature and back contact of relay 201, right-hand armature and contact of relay 204, conductor 218, right hand winding, armature and contact of relay 329, contact 323 (1 to 3) of sequence switch 320 through the winding of sequence switch 150 to battery. In parallel to this circuit, a circuit is also closed for the left-hand winding of relay 329 to ground at the normal contact of relay 213. Relay 329 being differential does not attract its armature when both windings are energized.

When relay 201 retracts its armature on the first impulse, relay 334 deenergizes and closes a circuit from ground over its armature and back contact, and contact 333 (2) to drive sequence switch 320 out of position 2 and into position 3. The movement of sequence switch 320 from position 2 to 3, does not disturb the circuit above traced for sequence switch 150, since contact 323 is closed in position 1 to 3. Sequence switch 150 energizes and moving out of position 0 closes at its local contact 151, a short circuit around the right-hand winding of differential relay 329. This relay attracts its armature and sequence switch 150 continues to move under the control of its local contact into position 1. Relay 329 deenergizes and at the second retraction of the armature of relay 201 in response to the second impulse of the series, the above traced circuit is again closed to drive sequence switch 150 out of position 1, where it causes the energization of relay 329 as described. Under the control of local contact 151, sequence switch 150 advances into position 2. This operation proceeds, the sequence switch 150 moving through one position for each impulse sent out from the calling subscriber's station, and finally comes to rest in a position corresponding to the digit transmitted. The relay 334 being slow to attract its armature, does not again energize due to the brief closures of its circuit by relay 201 during the impulse series. At the end of the series, however, when relay 201 attracts its armature for a relatively long period, relay 334 again has time to energize, and in so doing closes a circuit over its armature and front contact, and contact 333 (3) to drive sequence switch 320 out of position 3 and into position 4. The sequence switch 150 which like the registers 110, 120, 130 and 140, is provided with 10 circuit-controlling positions, now runs through the remaining positions of its cycle from the position to which it was advanced by the calling dial, to control the positioning of the first register 110. The circuit for driving sequence

switch 150, from the position to which it has been set, back to its normal position, may be traced from battery, through the winding of said sequence switch, contact 152, contact 336 (4) to ground. In passing through its successive half positions on its way back to normal, sequence switch 150 intermittently closes a circuit for register 110 traceable from battery, through the winding of said register, contact 328 (4) and contact 153 of sequence switch 150 to ground. Upon reaching its zero position, sequence switch 150 closes a circuit from battery, through the winding of sequence switch 320, contact 337 (4) and contact 154 (0) to ground, to drive sequence 320 into position 5. The positioning of the first register 110 under the control of the sequence switch 150 has taken place during the time the calling subscriber is adjusting his dial after the transmission of the second series of impulses so that the apparatus at the called exchange is now in readiness to receive the third series of impulses.

When the first interruption of the trunk circuit 200 occurs during the sending of the third series of impulses, relay 201 retracts its armature and completes a circuit from ground, normal contact of relay 213, armature and back contact of relay 201, right-hand armature and contact of relay 204, through the right-hand winding, armature and contact of relay 329, contact 323 (5) to the sequence switch 150. At the same time, the energizing circuit of the relay 334 is opened, and by retracting its armature this relay closes a circuit over sequence switch contact 333 (5) to drive sequence switch 320 out of position 5 into position 6. The sequence-switch 150 energizes, and again moves from position 0 into position 1. In the manner described with respect to the preceding series of impulses, the sequence switch 150 advances one step for each impulse, coming to rest in the position depending upon the third digit of the called number. At the end of the third series when relay 201 attracts its armature for a comparatively long period, the relay 334 again energizes and closes a circuit over its armature and front contact and sequence switch contact 333 (6) to drive sequence switch 320 out of position 6 into position 7. In position 7 of sequence switch 320 a circuit including contact 336 (7) and contact 152 is completed to drive sequence switch 150 back to its normal position 0. When passing through each of its successive half positions sequence switch 150 closes a circuit from ground, contact 153, contact 328 (7), through the winding of the second register 120 to battery and ground. The register 120 is thereby set up to a position corresponding to the complement of the third digit. On reaching position 0, sequence switch 150

closes a circuit including contact 154 and contact 337 (7) to drive switch 320 into position 8.

When the fourth series of impulses is sent, the relay 201 retracting its armature for the first interruption opens the circuit of relay 334 which by deenergizing closes a circuit including its armature and back contact and contact 333 (8) to drive sequence switch 320 out of position 8 and into position 9. Relay 201 also closes a circuit over its armature and back contact including the right hand winding, armature and contact of relay 329, and sequence switch contact 323 (9) for energizing the sequence switch 150. Under the control of stepping relay 201, sequence switch 150 is advanced to the proper position. At the end of the fourth series of impulses, relay 201 attracts its armature for a time sufficient for the energization of relay 334. Relay 334 closes a circuit from ground over its armature and front contact, contact 333 (9) to the winding of sequence switch 320 to drive said sequence switch out of position 9 and into position 10. In position 10 of sequence switch 320, a circuit is closed at contact 336 to again drive the sequence switch 150 back to its normal position to control the setting of the tens register 130. In passing through its half positions, while returning to position 0, sequence switch 150 intermittently opens and closes the circuit from ground, contact 153, contact 328 (10) through the winding of register 130 to battery and ground. Register 130 is driven to a position corresponding to the fourth digit of the called number. When sequence switch 150 reaches position 0, a circuit is completed from ground, contact 154 (0), contact 337 (10) through the winding of sequence switch 330 to battery and ground. Sequence switch 320 moves into position 11.

The final series of impulses are now transmitted from the calling subscriber's station. At the first retraction of the armature of relay 201 in response to the first interruption of such impulse series the relay 334 is deenergized and closes a circuit including contact 333 (11) to drive sequence switch 320 out of position 11 and into position 12. The first retraction of the armature of relay 201 also closes a circuit including the right-hand winding, armature and contact of differential relay 329 and sequence-switch contact 323 (12) for energizing the winding of sequence switch 150. In the manner now well understood, sequence switch 150 is advanced to its proper position under the control of the stepping relay 201. When the last impulse of the final series has been sent, and relay 201 retains its armature attracted, the slow to energize relay 334 energizes to close a circuit including contact 333 (12) for driving sequence switch 320 into posi-

tion 13. In position 13, sequence switch 150 is energized in a circuit including its contact 152 and contact 336 and runs through the remainder of its cycle to its 0 position to control the setting of the units register 140. The circuit for advancing the register 140 under the control of the sequence switch 150, may be traced from ground, contact 153, contact 328 (13), through the winding of the register 140 to battery and ground. On reaching its 0 position, sequence switch 150 closes a circuit including its contact 154 (0) and contact 337 (13) for driving the sequence switch 320 into position 14.

When the sequence switch 320 reached position 2, a circuit was closed from ground, contact 347 (2) of sequence switch 320, contact 352 (1) of sequence switch 350, through the winding of sequence switch 350 to battery and ground. Sequence switch 350 advances into position 2 by means of this circuit. In this position of sequence switch 350 relay 222, Fig. 2, is energized in a circuit from battery, through the winding of said relay, contact 225 (1) of sequence switch 220, left-hand armature and back contact of relay 215, left hand armature and contact of relay 206 through the winding of relay 355, armature and contact of relay 362, contact 357 (2) to ground. Relay 222 closes a circuit from ground, over its armature and front contact, armature and back contact of relay 232, contact 226 (1) through the winding of sequence switch 220 to battery, whereby sequence switch 220 is driven out of position 1 and into position 2. In position 2 of sequence switch 220, the above traced circuit for relay 222 is opened at contact 225 permitting relay 222 to deenergize. A circuit is thereupon closed from ground, armature and back contact of relay 222, contact 227 (2), through the winding of sequence switch 220 to battery to drive said sequence switch into position 3. When relay 355 energizes in position 2 of sequence switch 350, a circuit is closed from battery, through the winding of sequence switch 350, contact 354 (2), left-hand winding of relay 362, front contact and armature of relay 355 to ground, thereby energizing sequence switch 350 to drive it out of position 2 and into position 3. In parallel to this circuit, a circuit is also closed from battery through the right-hand winding of relay 362, contact 354 (2), through the left-hand winding of relay 362 to ground at the armature of relay 355. The relay 362 is made differential, and will not attract its armature when both windings are energized to open the above traced circuit for relay 222 which resulted in the driving of sequence switch 220 out of position 1 and into position 2. This expedient provides that sequence switch 220 is driven as described into position 2 before sequence switch 350 leaves position 2. The

sequence switch 350 remains in position 3 until sequence switch 320 arrives in position 5, at which time a circuit is closed from ground, contact 347 of sequence switch 320, contact 352 (3) of sequence switch 350 through the winding of sequence switch 350 to drive the same out of position 3 and into position 4. A circuit is now closed from battery through the winding of relay 222 contact 225 (3), left-hand armature and back contact of relay 215, left-hand armature and contact of relay 206, through the winding of relay 355, armature and contact of relay 362 to ground at contact 357 (4). Relay 222 by energizing closes a circuit from ground over its armature and front contact, armature and back contact of relay 232, contact 226 (3) through the winding of sequence switch 220 to battery to drive sequence switch 220 into position 4.

In position 4 of sequence switch 220, the trip spindle power magnet 248 of the first group selector is energized in a circuit from battery, through the winding of said magnet, contact 247 (4), front contact and armature of relay 222 to ground. The trip spindle rotates in a continuous movement to select the proper set of brushes, and for each brush tripping position passed over, the interrupter contact 255 provides a circuit to ground including contact 249 for relay 222, in shunt of the stepping relay 355 at the register set. Relay 222, however, remains energized while at the first closure of the contact 255, relay 355 releases its armature. The retraction of the armature of relay 355 completes a circuit from battery through the winding of the register 110, contact 112, contact 361 (4), contact and armature and left-hand winding of relay 359, back contact and armature of relay 355 to ground. In parallel to this circuit a circuit is also closed from battery, contact 363 (4) through the right-hand winding of relay 359 to ground at the armature of relay 355. The relay 359 being differential does not operate when both of its windings are energized. The register 110, however, energizes in the circuit traced and moves out of the position to which it was adjusted under the control of sequence switch 150. When the local contact 136 of register 110 is closed, the left-hand winding of relay 359 is short-circuited permitting said relay to attract its armature. Under the control of its local contact, the register 110 advances to its next position. When the shunt in the fundamental circuit is removed by the opening of the contact 255 of the interrupter, the stepping relay 355 energizes and causes the deenergization of relay 359. At the next short circuiting of relay 355, register 110 is again energized and advances in the manner described through another position. This procedure continues until register 110 has reached its 0 position.

Upon the next retraction of the armature of relay 355, after register 110 has reached its 0 position, a circuit is closed from battery, through the winding of sequence switch 350, contact 354 (4), contact 114 (0), contact 361 (4), contact and armature and left-hand winding of relay 359, back contact and armature of relay 355 to ground. In parallel thereto a circuit is closed from battery, through the right-hand winding of relay 362 to ground at the armature of relay 355. The relay 362 operates to open the fundamental circuit, while sequence switch 350 energizing in the circuit traced moves out of position 4 and into position 5. When the interrupter contact 255 opens after relay 362 has been energized to interrupt the fundamental circuit, relay 222 deenergizes and closes a circuit from ground over its armature and back contact, contact 227 (4) through the winding of sequence switch 220 to battery to drive said sequence switch into position 5.

In position 5 of sequence switch 220, the brush carriage power magnet 261 is energized by means of a circuit from battery, through the winding of said magnet, contact 226 (5), back contact and armature of relay 232 to ground at the front contact and armature of relay 222. It will be noticed that relay 222 immediately energized as sequence switch 228 moved into position 5 over a circuit including contact 225 (5) and the back contact and armature of relay 216. The brush carriage of the group selector rotates to advance the selected set of brushes over the terminals of trunks to the succeeding group of selector switches. When an idle trunk is found, which idle condition is identified by means of a selectable potential on the test terminal, the test relay 234 is energized in a circuit over the test terminal 280, test brush 281, through the left-hand high resistance winding of relay 234 to ground at sequence switch contact 238 (5). Test relay 234 attracting its armature closes a low resistance path to ground through its right-hand winding armature and contact, winding of relay 232, and sequence switch contact 238, in shunt of the circuit traced through the high resistance winding of the relay 234. This low resistance path serves in the well known manner to reduce the potential of the multiples of the seized trunk to render the same non-selectable to other switches. Relay 232 by attracting its armature, opens the circuit of the power magnet 261 to bring the brush carriage to rest and at its front contact closes a circuit from battery, through the winding of sequence switch 220, contact 228 (5), front contact and armature of relay 232, to ground at the front contact and armature of relay 222. The sequence switch 220 moves into position 6. The fundamental circuit is now

extended over contacts 279 and 278 to the second group selector 282, in the well known manner. This fundamental circuit leads from the second group selector 282 over the brush 283, contact 278 (6) left-hand armature and back contact of relay 215, left-hand armature and contact of relay 206, through the winding of stepping relay 355, armature and contact of relay 362, contact 357 (7), contact and right-hand armature of relay 206, back contact and right-hand armature of relay 215, contact 279 (6), brush 284, and thence to the selector 282. It is to be noted that the sequence switch 350 was driven into position 7 as soon as sequence switch 320 reached position 8, by means of a circuit from ground, contact 340, contact 356 (5), through the winding of sequence switch 350 to battery. Brush selection takes place at the second group selector 282 in the well known manner, the stepping relay 355 in the fundamental circuit being deenergized for each brush tripping position passed over by the tripping spindle. At each retraction of the relay 355, a circuit is closed from ground, armature and back contact of said relay, left-hand winding and armature and contact of differential relay 359, contact 361 (7), contact 122, through the winding of register 120 to battery and ground. When the register 120 reaches position 0, the next retraction of the armature of relay 355 thereafter closes a circuit from battery, through the winding of sequence switch 350, contact 354 (7), contact 114 (0), contact 124 (0), contact 361 (7), armature and contact and left-hand winding of relay 359 to ground over the back contact and armature of relay 355. The sequence switch 350 energizes and moves out of position 7 and into position 8. In parallel to the circuit just traced, the right-hand winding of relay 362 is also energized in a circuit including contact 354 (7). Upon the sequence switch 320 reaching position 11, the sequence switch 350 is energized in a circuit over contact 341 (11) and contact 342 (8) and moves into position 9. At the termination of trunk selection at the second group selector 282, the fundamental circuit is extended to the final selector 285, and the stepping relay 355 again energizes.

The brush tripping spindle of the final selector is rotated in the well known manner, and the stepping relay 355 in the fundamental circuit is intermittently deenergized and energized. At each deenergization of relay 355, the circuit is closed from ground, armature and back contact of relay 355, left-hand winding and armature and contact of relay 359, contact 360 (9), contact 137, through the winding of the tens register 130 to battery and ground. The register 130 upon reaching its 0 position closes a circuit from battery, through the winding of se-

quence switch 350, contact 364 (9), contact 138 (0), contact 360 (9) to ground at the back contact and armature of relay 355. Sequence switch 350 energizes in this circuit and moves into position 10. Relay 362 is energized to open the fundamental circuit by means of a circuit through the right-hand winding of said relay, contact 364 (9) and thence to ground at the armature and contact of relay 355 as above traced.

The sequence switch 350 remains in position 10 until sequence switch 320 has reached position 14, at which time a circuit is closed from ground over contact 343 (14) and contact 356 (10) to drive sequence switch 350 into position 11. In position 11 of sequence switch 350, the fundamental circuit is again closed at contact 357. The brush carriage of the final selector 285 rotates in the usual manner and for each retraction of the armature of the relay 355, caused by the short-circuiting interrupter contact, a circuit is completed from ground, armature and back contact of relay 355, left-hand winding and armature and contact of differential relay 359, contact 360 (11), contact 143 of the units register 140, through the winding of said register to battery and ground. The register 140 is restored to its 0 position, and upon reaching such position a circuit is closed from battery, through the winding of sequence switch 350, contact 364 (11), back contact and right-hand armature of relay 374, contact 144 (0), contact 360 (11) and thence to ground at the back contact and armature of relay 355. Relay 362 is energized in parallel to the circuit traced to open the fundamental circuit, whereas the sequence switch 350 moves from position 11 into position 1. A circuit is now closed from battery through the winding of sequence switch 320, contact 337 (14-15) to ground at contact 369 (1). The sequence switch 320 moves over position 15 and comes to rest in its normal position 1.

On leaving position 11, sequence switch 350 opens at its contact 358, the energizing circuit of relays 339, 204, 206 and 205. The relay 339, deenergizing, renders the register controlling mechanism which is now restored to its normal position selectable by other cord circuits. The relay 205 retracting its armature closes a circuit from ground, left-hand armature and back contact of relay 214, armature and back contact of relay 205, armature and back contact of relay 208, contact 235 (6), through the winding of sequence switch 220 to battery. Sequence switch 220 is driven from position 6 into position 7, where the right-hand windings of the repeating coil 229 are connected through to the final selector over sequence-switch contacts 279 and 278. When the brushes of the final selector 285 are set upon the terminals of the called line, the connect-

ing circuit is closed momentarily in any desirable manner to cause the energization of supervisory relay 242 in the cord circuit of the first group selector. Relay 242 attracting its armature, closes a circuit from battery, through the winding of sequence switch 220 contact 235 (7), front contact and armature of supervisory relay 242, front contact and armature of relay 222 to ground, whereby sequence switch 220 advances into position 8. When supervisory relay 242 again deenergizes, sequence switch 220 is moved into position 10 by means of a circuit including contact 228 (8), back contact and armature of relay 242, front contact and armature of relay 222 to ground. On leaving position 9, the sequence switch 220 opens at contact 223 the circuit in series with the right-hand winding of the line relay 201 which, up to this time, has been maintained in shunt of the high resistance winding of the relay 213. The high resistance relay 213 is now introduced in series with the trunk circuit 200, but is without effect at this time.

If the called subscriber responds, the removal of his receiver from the switchhook closes a circuit for the supervisory relay 242. A circuit is thereupon completed from battery through the winding of sequence switch 220, contact 235 (10), front contact and armature of relay 242, front contact and armature of relay 222 to ground. Sequence switch 220 moves into position 13 where the shunt around the high resistance 213 is again completed over contact 223 (13), front contact and armature of relay 242 and front contact and armature of relay 222 to ground. In position 13, a circuit is completed from battery through the winding of relay 202, contact 249 (13), contact 225 (13), back contact and armature of relay 216 to ground. Relay 202 attracts its armatures and reverses the direction of current over the trunk line 200 from the windings of line relay 201. This current reversal may be made use of for message registration or for any other purpose desired.

At the termination of the conversation, the release of the established connection takes place due to the calling subscriber replacing his receiver on the switchhook. The relay 108 is deenergized as soon as the calling subscriber hangs up his receiver and causes in turn the deenergization of slow-to-release relay 109. Relay 109 opens the holding circuit of relay 103 at its left-hand armature. The relay 103 being unable to retain its armatures attracted when in series with magnet 134 deenergizes and closes a circuit for the release magnet REL. This circuit may be traced from battery through said release magnet, primary off-normal contact PON back contact and inner armature of relay 103, to ground and back contact and

armature of relay 100. Magnet REL releases the first selector switch and restores the side switch to its normal position. The circuit of magnet 134 being open at the outer armature and contact of relay 103, the line switch is also restored to its normal position. As the line relay 108 at the repeater retracts its armature and relay 201 deenergizes permanently, a circuit is closed from battery through the winding of slow-to-operate relay 210, sequence switch contact 221, back contact and armature of relay 201, to ground at the normal contact of relay 213. Relay 210 closes a circuit at its armature and contact for the right-hand winding of slow operating relay 214. Relay 214, energizing, closes a locking circuit for itself over its left-hand armature and front contact and left-hand winding, through the windings of relays 216 and 215 to battery and ground. Relay 216 energizes and opens the hereinbefore traced circuits of relays 222 and 202. Relay 222 closes a circuit from ground over its armature and back contact, contact 227 (13), through the winding of sequence switch 220 to battery, to drive such sequence switch into position 16. In position 16, the brush carriage of the group selector is returned to its normal position by means of a circuit established from battery, through the winding of the brush carriage power magnet 261, contact 226 (16), back contact and armature of relay 232 to ground over the front contact and armature of relay 222. It will be observed that the relay 222 energized in a circuit including contact 238 as sequence switch 220 passed into position 16. In the normal position of the brush carriage a circuit is completed from battery, through the winding of holding magnet 262, contact 239 (16), brush 263 through the winding of relay 232 to ground at the contact of relay 238 (16). Relay 232 attracting its armature, opens the circuit of power magnet 261 and also closes a circuit to drive sequence switch 320 out of position 16 and into position 1. This latter circuit may be traced from battery through the winding of said sequence switch, contact 228 (16), front contact and armature of relay 232 to ground over the front contact and armature of relay 222. The release of the second group selector 282 and the final selector 285 may take place in any suitable manner.

Translation from the decimal system to the order of grouping made use of in selector switches of the character used in this system, is accomplished by means of relays 376 and 374 at the register controlling mechanism. If, for example, the thousand's digit is odd, the contact 135 of the register 110 will be closed. As sequence switch 350 passes through position  $3\frac{1}{2}$  in this case, relay 376 is energized in a circuit over contact 378 and contact 135, and locks up over

its right-hand armature to ground at sequence switch contact 368. With the relay 376 energized, sequence switch 350 is driven out of position 4 and into position 5 as soon as the register 110 reaches position 9, rather than position 0, as in the case of an even digit. Hence the tripping spindle of the first group selector is stopped in the same brush tripping position as though the lower even digit had been sent from the calling substation. Later, after register 120 has been restored to 0, the register 110 is driven from position 9 to position 0 by means of a circuit including the back contact and armature of relay 376, which deenergized when sequence switch contact 368 left position 4, contact 113 (9), contact 124 (0), contact 361 (7) to ground at the armature of relay 355. Therefore the tripping spindle of the second group selector is advanced through an additional position.

If the hundred's digit of the called number is odd, contact 126 of the register 120 will be closed, and relay 374 is energized in a circuit including contact 353 as sequence switch 350 passes through position 6. Relay 374 locks up in a circuit over its left-hand armature and contact to ground at contact 146. In passing through position  $6\frac{1}{2}$  sequence switch 350 momentarily closes its contact 381, and register 120 is driven through an additional position by means of a circuit including contact 122, contact 381, left-hand armature and contact of relay 374 to ground at contact 146. This causes the register 120 to advance to the next even position, which causes the brush tripping spindle of the second group selector to be moved under the control of the register 120 to the same brush tripping position as if the number dialled had been the lower even figure. Later, during unit selection when the register 140 reaches position 0, it continues to rotate through a complete additional cycle by means of a circuit including the front contact and right-hand armature of relay 374 and contact 144 (0). By this means the brush carriage of the final selector is driven to carry the selected set of brushes to the proper set of terminals in the odd hundred's section of the terminal bank. As the register 140 passes from position 0, to position 1, contact 146 is opened to open the circuit of relay 174 which consequently deenergizes.

It will be recalled that when a calling subscriber's line is extended over the step-by-step switches to a trunk line such as 200, leading to a distance exchange equipped with switches of the power-driven type, the resulting energization of the line relay 201 associated with the trunk 200, causes the energization of relay 203. The operation of relay 203 causes the energization of two relays 205 and 208 for selecting one or the

other of two register controlling mechanisms which serve the cord circuit of the first group selector shown in Fig. 2. It will also be observed that the relay 203 is normally energized in a circuit including sequence switch contact 224 in its first position. In other words, one of the two register controlling mechanisms allotted to a cord circuit is normally selectable by said cord circuit when the first group selector is in its restored position and its controlling sequence switch is in position 1. In a system of this character where an established connection may comprise, in part, a series of step-by-step switches and, in part, a series of power driven switches, it is apparent that upon release, the step-by-step switches are restored to normal in a very brief space of time, whereas a longer interval is required for the brush carriages of the power-driven switches to rotate back to their restored positions. It may occur that after the step-by-step switches have released, a second call is extended to the cord circuit of the first group selector employed in the previous call before such group selector has had sufficient time to restore. In accordance with the present invention provision is made whereby the cord circuit of a first group selector may be seized, and an idle register controlling mechanism associated therewith, during the interval that the group selector is restoring to its normal position. Assume that the release of an established connection has just been initiated, in which case, as above described, relays 214, 216 and 215 are energized in series with each other. Relay 216 opens the circuit of relay 222 which by releasing closes a circuit to start sequence switch 220 out of position 13. In positions 9 to 14, the high resistance relay 213 is short-circuited by a path to ground over the right-hand armature and front contact of relay 215 and sequence switch contact 238. If a call is extended to trunk 200 while sequence switch 220 is in position 13, relay 213 does not energize in series with relay 201 and a circuit for relay 203 is completed from ground, normal contact of relay 213, armature and front contact of relay 201, left-hand armature and back contact of relay 204, left-hand armature and back contact of relay 207, contact and right-hand armature of relay 214, through the winding of relay 203 to battery and ground. Relay 203 operates as already explained to select a line-controlling mechanism. The relay 213 does not energize in series with relay 201 in positions 14 to 18 of sequence switch 220 since it is short-circuited to ground at sequence switch contact 223. Should a call be extended over the trunk 200 while sequence switch 220 is in either position 14, 15 or 16, relay 203 is energized in the circuit above traced over

the contact and right-hand armature of relay 214. When sequence switch 220 reaches position 17, the left-hand winding of relay 214 is shunted out by a direct path to ground over contact 231 which results in relay 214 releasing its armatures. If now, a call comes in while sequence switch 220 is in position 17 or position 18, the energization of relay 201 closes a circuit from ground, normal contact of relay 213, front contact of relay 201, left-hand armature and back contact of relay 204, left-hand armature and back contact of relay 207, contact 224 (17—18), through the winding of relay 203 to battery. The relay 216 remaining energized in series with relay 215 until sequence switch 220 opens contact 231 on leaving position 18, provides a locking circuit at its armature and front contact either for the right-hand winding of relay 205 or the left-hand of relay 208, according to the register set seized, until relay 214 has deenergized to release its left-hand armature.

It will now be assumed that the step-by-step exchange shown in Fig. 1 is of the semi-automatic type where calls on subscribers' lines appear before and are handled by operators in the usual manner; for this purpose there is shown diagrammatically, the calling end of an operator's cord circuit 141, including the calling plug 142, adapted to be inserted in jacks such as 143 which lead to the first selector switches as shown by the dotted lines 147, 148 and 149. In this embodiment of the system a conductor 145 such as shown by the dotted line leads from the back contact of relay 117 to the non-grounded side of resistance 118.

When a call appears before the operator, she answers it in the well-known manner by inserting the answering plug, (not shown), in the jack of the calling line. Upon learning the number of the desired line, she inserts the calling plug 142 in the jack 143 and operates her impulse sender 155 to transmit the required digits. The operator's sender 155 serves exactly the same as a calling subscriber's transmitter to set the step-by-step switches in the first exchange, and to control the positioning of a register set in the distant exchange. After the operator has completed the sending of impulses she closes key 156, which includes relay 157 in series with the windings of relay 108 at the repeater. If the called line is found to be idle, sequence switch 220 of the group selector goes into position 10, as explained, where the high resistance relay 213 is included in series with relay 201 and relay 117 at the repeater. Relay 117 being marginal releases its armature and closes a circuit from battery through the winding of relay 103, side switch arm 107 (position 3), brush 125, left-hand armature and contact of relay 109, conductor 145 to ground

at the armature of relay 117. This path to ground short-circuits the supervisory relay 158 which would otherwise be energized in series with relay 103 over a circuit from battery through the winding of relay 103, side-switch arm 106 (position 3), contact and outer armature of relay 103, conductor 149, sleeve of jack 143 and plug 142, through the winding of relay 158 to ground. Relay 158 by being deenergized closes a circuit for the lamp 159 which indicates to the operator that ringing current is being placed upon the called line. When the called subscriber answers and sequence switch 220 moves into position 13, the high-resistance relay 213 is short-circuited over contact 223 (13) front contact and armature of relay 242, front contact and armature of relay 222 to ground. The removal of the resistance of relay 213, permits relay 117 at the repeater to energize and open the conductor 145. This includes the resistance 118 in a circuit parallel to the circuit traced for the supervisory relay 158. The resistance 118 being sufficiently high, relay 158 now receives enough current to energize and extinguish lamp 159. The effacement of lamp 159 indicates to the operator that the called party has responded. At the termination of conversation, the connection is released by the removal of plug 142 from the jack 143.

What is claimed is:

1. In a telephone exchange system, a calling line, a plurality of step-by-step switches, means for directly operating said switches to extend the calling line, a plurality of switches each arranged to be driven in a continuous movement, a switch-controlling mechanism, means for variably setting said mechanism, and means controlled by said mechanism for selectively controlling the operation of said last named switches to further extend the calling line.

2. In a telephone exchange system, a calling line, a plurality of step-by-step switches, means under the control of the calling line for directly operating said switches to extend the calling line, a plurality of switches each arranged to be driven in a continuous movement, a switch controlling mechanism, means under the control of the calling line for variably setting said mechanism, and means controlled by said mechanism for selectively controlling the operation of said last named switches to further extend the calling line.

3. In a telephone exchange system, a calling line, a plurality of step-by-step switches, means for directly operating said switches to extend the calling line, a plurality of switches each arranged to be driven in a continuous movement, a set of registers, means for variably positioning said registers, and means under the control of said

registers for selectively controlling the operation of said last named switches to further extend the calling line.

4. In a telephone exchange system, a calling line, a plurality of step-by-step switches, means under the control of the calling line for directly operating said switches to extend the calling line, a plurality of switches each arranged to be driven in a continuous movement, a set of registers, means under the control of the calling line for variably positioning said registers, and means under the control of said registers for selectively controlling the operation of said last named switches to further extend the calling line.

5. In a telephone exchange system, an exchange having step-by-step switches therein, a subscriber's line terminating in the exchange, a distant exchange having switches therein each arranged to be driven in a continuous movement, a switch-controlling mechanism, a trunk interconnecting said exchanges, means for operating said step-by-step switches to connect the calling line over said trunk to said distant exchange, means for variably setting said controlling mechanism, and means under the control of said mechanism for selectively controlling the operation of said last named switches to further extend the calling line.

6. In a telephone exchange system, an exchange having step-by-step switches therein, a subscriber's line terminating in the exchange, a distant exchange having switches therein each arranged to be driven in a continuous movement, a switch-controlling mechanism, a trunk interconnecting said exchanges, means under the control of said line for operating said step-by-step switches to connect the calling line over said trunk to said distant exchange, means under the control of said line for variably setting said controlling mechanism and means under the control of said mechanism for selectively controlling the operation of said last named switches to further extend the calling line.

7. In a telephone exchange system, a plurality of step-by-step switches for extending subscriber's lines, a plurality of switches each arranged to be driven in a continuous movement for extending subscribers' lines, a sender arranged to send impulse series in accordance with the designations of called lines, means responsive to certain impulse series sent by said sender for operating said step-by-step switches, and means responsive to other impulse series sent by the sender for controlling the operation of said continuously driven switches.

8. In a telephone exchange system, a plurality of step-by-step switches for extending subscribers' lines, a plurality of switches each arranged to be driven in a continuous movement for extending subscribers' lines, a

switch-controlling mechanism, a sender arranged to send impulse series in accordance with the designations of called lines, means responsive to certain impulse series sent by said sender for operating said step-by-step switches, means responsive to other impulse series sent by said sender for setting said controlling mechanism, and means responsive to said controlling mechanism for controlling the operation of said continuously driven switches.

9. In a telephone exchange system, a subscriber's line, a sender associated with said line arranged to transmit impulse series in accordance with the designations of called lines, step-by-step switches for extending said line, switches each arranged to be driven in a continuous movement for further extending said line, means responsive to certain impulse series transmitted by said sender for operating said step-by-step switches, and means responsive to other impulse series transmitted by said sender for controlling the operation of said continuously driven switches.

10. In a telephone exchange system, a subscriber's line, a sender associated therewith arranged to be variably operated to send a group of impulse series corresponding to the digits of a called number, step-by-step switches, switches each arranged to be driven in a continuous movement, means responsive to a definite number of the first series of said group for operating said step-by-step switches to extend said line, and means responsive to the remaining impulse series of said group for controlling the operation of said continuously driven switches to further extend said subscriber's line.

11. In a telephone exchange system, a subscriber's line, switches for extending said line, a controlling mechanism comprising a plurality of registers each having a series of controlling positions, means for sending series of impulses, means responsive to said impulse series for setting said registers in positions complementary to the number of impulses contained in said impulse series, and means controlled by said registers for setting said switches.

12. In a telephone exchange system, a subscriber's line, switches for extending said line, a controlling mechanism comprising a plurality of registers each having a series of controlling positions, a sender associated with each line for sending series of impulses, means responsive to said impulse series for setting said registers in positions complementary to the number of impulses contained in said impulse series, and means controlled by said registers for setting the said switches.

13. In a telephone exchange system, a subscriber's line, switches for extending said line, a controlling mechanism comprising a

plurality of registers each having a series of controlling positions, means for sending series of impulses, means associable successively with the registers of said set and responsive to said impulse series for setting said registers in positions complementary to the number of impulses contained in said impulse series, and means controlled by said registers for setting said switches.

14. In a telephone exchange system, a subscriber's line, switches for extending said line, a controlling mechanism comprising a plurality of registers each having a series of controlling positions, means for sending series of impulses, a sequence switch associable successively with the registers of said set and responsive to said impulse series for setting said registers in positions complementary to the number of impulses contained in said impulse series, and means controlled by said registers for setting said switches.

15. In a telephone exchange system, a subscriber's line, a plurality of step-by-step switches, a plurality of switches each arranged to be driven in a continuous movement, a controlling mechanism comprising a plurality of registers each having a series of controlling positions, means for sending series of impulses, means responsive to certain of said impulse series for setting said step-by-step switches to extend the subscriber's line, means responsive to other of said impulse series for setting the registers of said set in positions complementary to the number of impulses contained in said other impulse series, and means controlled by said registers for setting said continuously driven switches to further extend the subscriber's line.

16. In a telephone exchange system, a subscriber's line, a selective switch, a trunk line terminating in said switch, means for extending the subscriber's line over said trunk to said switch, a register controlling mechanism for controlling said switch, means controlled over said trunk for seizing said register controlling mechanism when said switch is in its normal position, means for rendering said register controlling mechanism non-selectable over said trunk when the switch is engaged, and means for rendering said register controlling mechanism selectable over said trunk during the release of said switch.

17. In a telephone system, a trunk, a selective switch in which said trunk terminates, a controlling mechanism, means for extending a connection over said trunk to the selective switch, means for connecting said mechanism to said trunk, means controlled by said mechanism for operating the selective switch, means for releasing said trunk and selective switch, means for extending another connection over the trunk while said

switch is releasing, and means for connecting said mechanism to said trunk during release of the selective switch.

18. In a telephone system, a trunk, a selective switch in which said trunk terminates, a register controlling mechanism, means for extending a connection over said trunk, means for connecting said controlling mechanism to said trunk, means controlled over said trunk for setting said mechanism, means controlled by said mechanism for operating the selective switch, means for releasing said trunk and selective switch, means for extending a second connection over the trunk while said switch is releasing, and means for connecting said register mechanism to said trunk during the release of the selective switch.

19. In a telephone system, a trunk, a selective switch in which said trunk terminates, a register controlling mechanism, means for extending a connection over said trunk to the selective switch, means for connecting said mechanism to said trunk, means controlled over said trunk for setting the register mechanism, means controlled by said mechanism for operating the selective switch, means for releasing said trunk and said selective switch, and means for extending another connection over the trunk while said switch is releasing, said controlling mechanism arranged to be connected to said trunk in response to the extension of said second connection during the release of the selective switch, said mechanism being arranged to take a setting over said trunk during the release of the selective switch.

20. In a telephone system, a trunk, a selective switch in which said trunk terminates, a register controlling mechanism, means for extending a connection over said trunk to the selective switch, means responsive to the extension of such connection for connecting said mechanism to the trunk, means for transmitting impulses over the trunk for setting said register mechanism, means controlled by said mechanism for operating the selective switch, means for releasing said trunk and selective switch, and means for extending another connection over the trunk while said switch is releasing, said mechanism being arranged to be connected to said trunk in response to the extension of said second connection during the release of said switch, said mechanism being arranged to take a setting in response to impulses transmitted over said trunk during the release of said selective switch.

21. In a telephone system, a telephone line, a step-by-step switch, a second switch arranged to be driven in a continuous movement, means for directly operating said step-by-step switch to extend the telephone line to said second switch, a switch controlling mechanism, means for setting said

mechanism, and means controlled by said mechanism for selectively operating said second switch to further extend the telephone line.

22. In a telephone exchange system, a calling line, a plurality of selector switches, switch controlling mechanisms, means associated with said calling line for directly operating one of said switches to select a controlling mechanism and for thereafter controlling the variable setting of said mechanism, and means controlled by said mechanism for selectively controlling the operation of other of said switches to extend a connection from the calling line.

23. In a telephone exchange system, a calling line, a plurality of selector switches, switch controlling mechanisms, each comprising a plurality of registers, a step-by-step selector switch for extending the calling line to said first-named selector switches, means associated with said calling line for directly operating said step-by-step selector switch to select a controlling mechanism and for thereafter controlling the variable setting of the registers of said mechanism, and means controlled by said mechanism for selectively controlling the operation of said first named selector switches to further extend the calling line.

24. In a telephone exchange system, a calling line, a plurality of selector switches, a switch controlling mechanism, means associated with said calling line for directly operating one of said switches to select said controlling mechanism, and for thereafter controlling the variable setting of said mechanism, and means controlled by said mechanism for selectively controlling the operation of other of said switches to extend a connection from the calling line.

25. In a telephone exchange system, a calling line, a called line, a first plurality of selector switches for extending said calling line toward said called line, a switch controlling mechanism comprising a plurality of registers, means associated with said calling line for directly operating one of said first plurality of switches to select said controlling mechanism and for thereafter controlling the variable setting of the registers of said mechanism, a second plurality of selector switches, and means controlled by said mechanism for selectively controlling the operation of said second plurality of selector switches to complete extension of said calling line to said called line.

26. In a telephone exchange system, a calling line, a plurality of selector switches, a switch controlling mechanism, means associated with said calling line for directly operating certain of said switches to select said controlling mechanism and for thereafter controlling the variable setting of said

mechanism, and means controlled by said mechanism for selectively controlling the operation of other of said switches to extend a connection from the calling line.

27. In a telephone exchange system, a calling line, a called line, a first plurality of selector switches for extending said calling line toward said called line, switch controlling mechanisms, each comprising a plurality of registers, means associated with said calling line for directly operating certain of said first plurality of switches, in accordance with the office designation of said called line to select a controlling mechanism, and for thereafter controlling the variable setting of the registers of said mechanism in accordance with the numerical designation of said line, a second plurality of selector switches and means controlled by said mechanism for selectively controlling the operation of certain of said second plurality of selector switches to complete extension of said calling line to the said called line.

28. In a telephone system, a trunk, a selective switch in which said trunk terminates, a register sender, means for extending a connection over said trunk to the selective switch, means for connecting said sender to said trunk, means controlled over said trunk for setting the sender, means controlled by said sender for operating the selective switch, means for releasing said trunk and selective switch, means for extending another connection over the trunk while said switch is releasing, and means for connecting said sender to said trunk during the release of the selective switch.

29. In a telephone system, a trunk, a selective switch in which said trunk terminates, a register sender, means for extending a connection over said trunk to the selective switch, means for connecting said sender to said trunk, means controlled over said trunk for setting the sender, means controlled by said sender for operating the selective switch, means for releasing said trunk and selective switch, and means for extending another connection over the trunk while said switch is releasing, said sender arranged to be connected to said trunk in response to the extension of said second connection during the release of the selective

switch, said sender being arranged to take a setting in response to impulses transmitted over said trunk during the release of the selective switch.

30. In a telephone system, a trunk, a selective switch in which said trunk terminates, a register sender, means for extending a connection over said trunk to the selective switch, means responsive to the extension of such connection for connecting said sender to the trunk, means for transmitting impulses over the trunk for setting said sender, means controlled by said sender for operating the selective switch, means for releasing said trunk and selective switch, and means for extending another connection over the trunk while said switch is releasing, said sender being arranged to be connected to said trunk in response to the extension of said second connection during the release of said switch, said sender being arranged to take a setting in response to the impulses transmitted over said trunk during the release of said selective switch.

31. In a telephone system, an office, a second office, a two-conductor trunk interconnecting said offices, a selective switch in the second office in which said trunk terminates, a register sender, means at the first office for selecting said trunk to extend a connection thereover to the selective switch, means for connecting said register sender to the trunk in response to the extension of such connection, means controlled over said trunk for setting the sender, means controlled by said sender for operating the selective switch to further extend the connection, means for releasing said trunk at the first office to cause the release of said selective switch, and means for selecting said trunk at the first office to extend a second connection thereover while said selective switch is releasing, said sender being arranged to be connected to said trunk in response to the extension of said second connection during the release of the selective switch, said sender being arranged to take a setting by means controlled over said trunk during the release of the selective switch.

In witness whereof, I hereunto subscribe my name this 4th day of June A. D., 1919.

LIPA POLINKOWSKY.