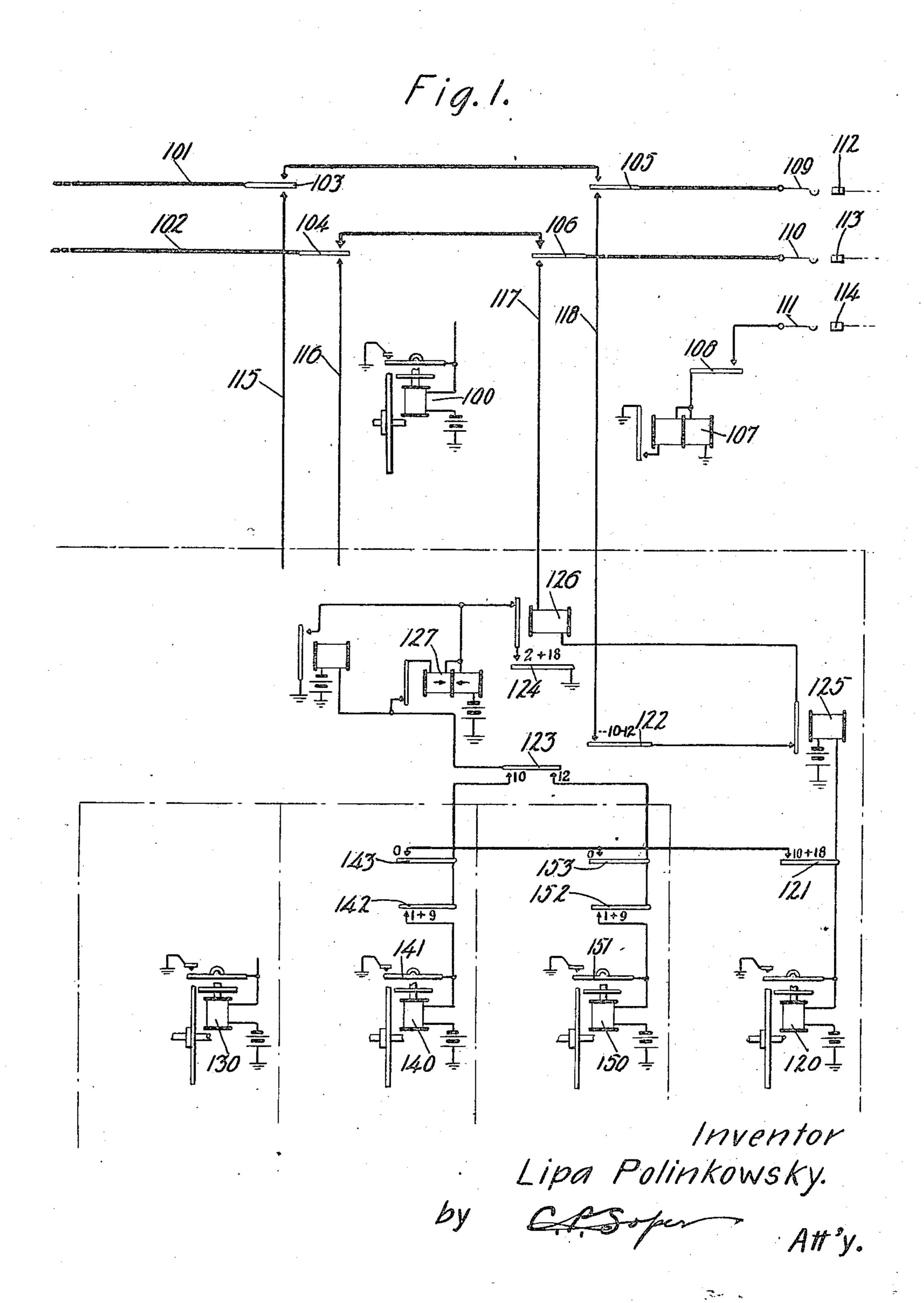
L. POLINKOWSKY

TELEPHONE EXCHANGE SYSTEM

Filed April 30 1920

3 Sheets-Sheet 1



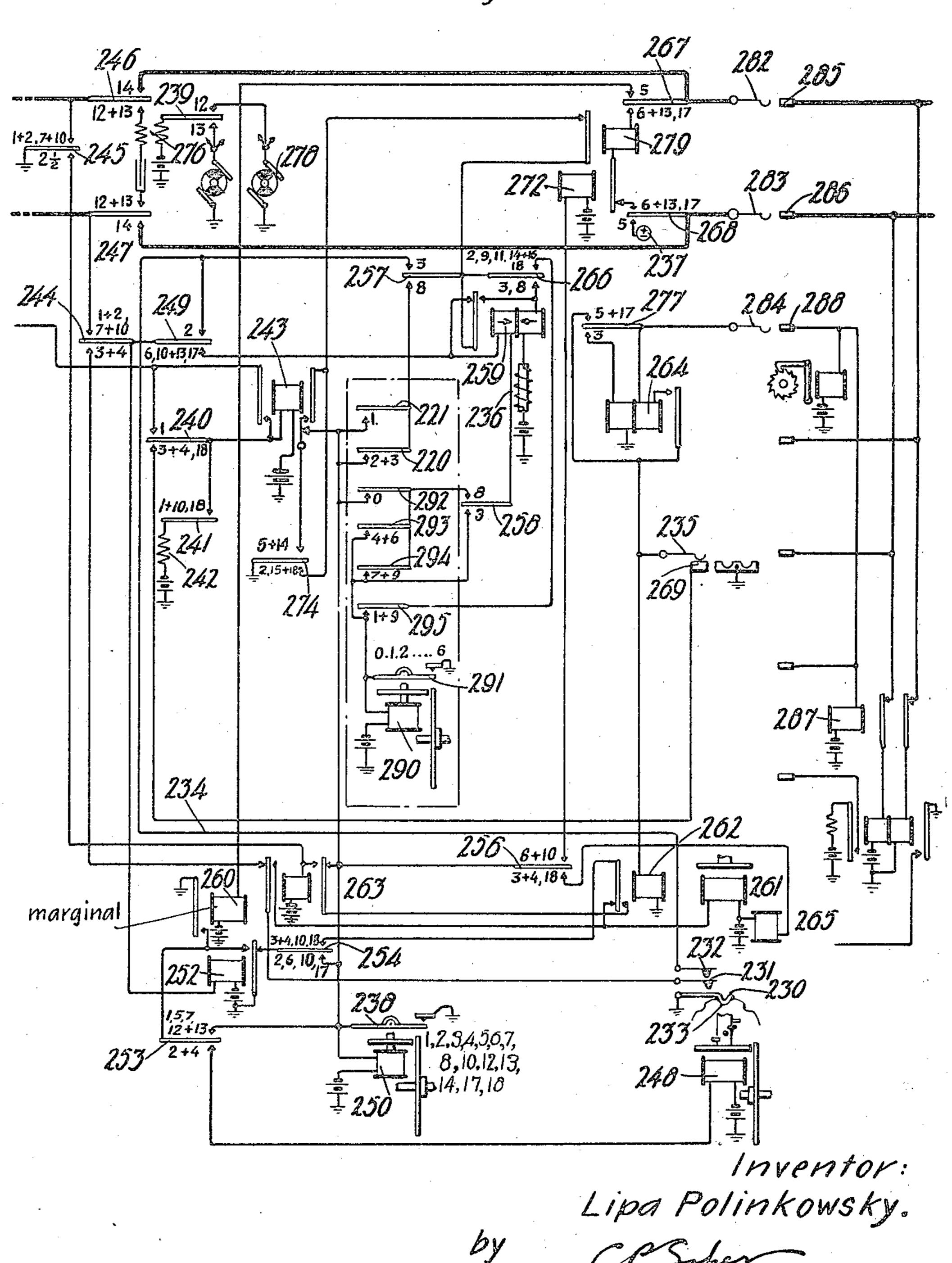
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Fig. 2.

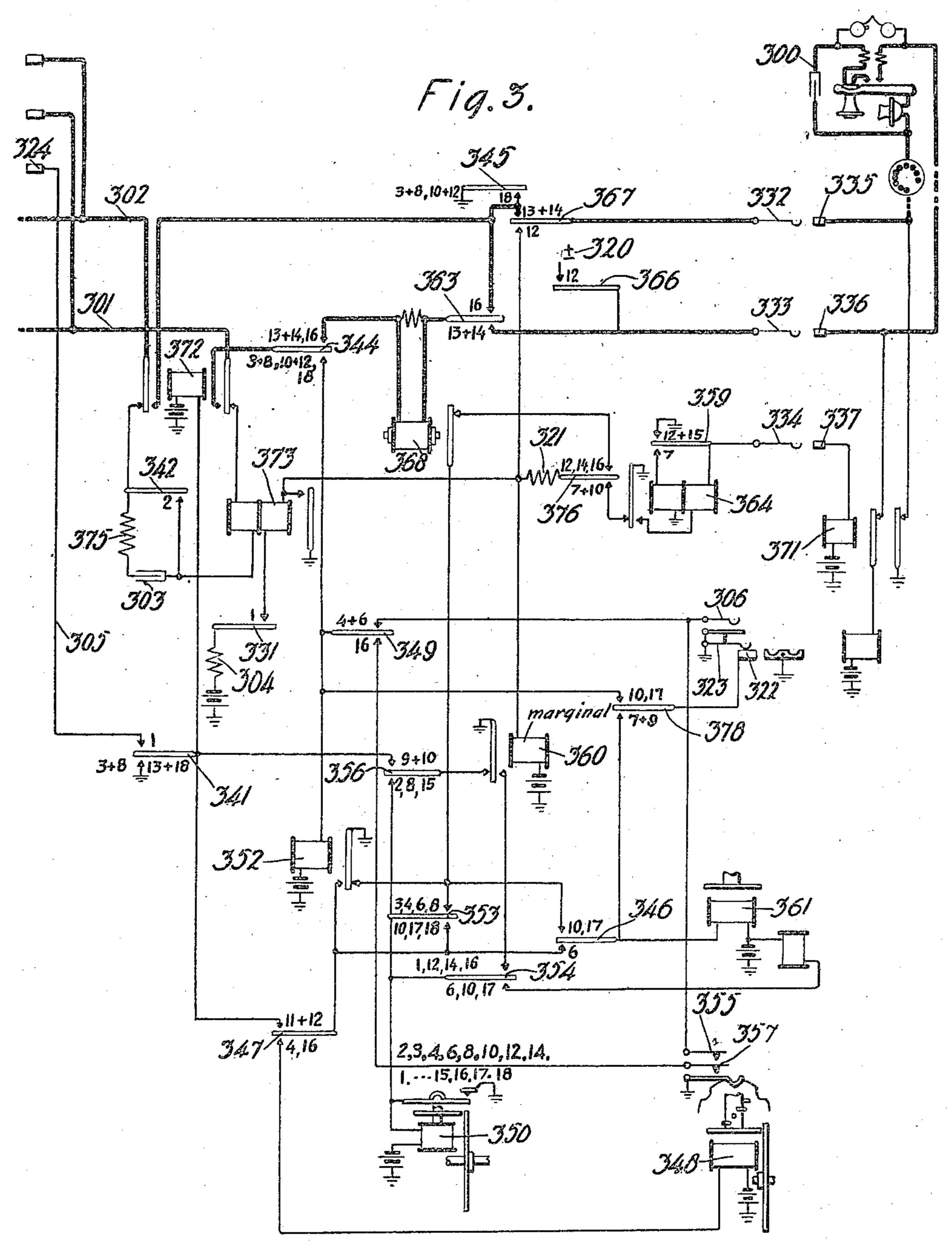


L. POLINKOWSKY

TELEPHONE EXCHANGE SYSTEM

Filed April 30, 1920

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Lipa Polinkowsky.

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UNITED STATES PATENT OFFICE.

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

TELEPHONE-EXCHANGE SYSTEM.

Application filed April 30, 1920. Serial No. 377,980.

To all whom it may concern:

Be it known that I, LIPA POLINKOWSKY, a citizen of Russia, residing at Antwerp, Belgium, have invented certain new and use-5 ful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone sys-10 machine switching apparatus is used for establishing connections between subscribers'

lines.

switches in the extension of a connection.

A feature of the invention relates to the a succeeding switch in the extension of a connection.

Another feature of the invention relates to the provision of means, operative on the lines extending between such switches.

Other features of the invention will become more apparent from a consideration 35 of the following description and appended claims.

In the drawings, Figs. 1, 2 and 3, taken in order illustrate so much of a telephone system as is necessary to an understanding of the invention.

branch exchange. Fig. 3 shows the incoming end of the central office trunks terminating in connecting switches in the private branch exchange.

In the system disclosed there is provided a central office equipped with group selector switches such as the one illustrated diagrammatically in Fig. 1, and a register control-

ling mechanism for controlling the selective operation of these switches and also succeed- 55 ing switches in the establishment of connections. There is also provided in the central office special selective switches, such as the one shown in Fig. 2, for extending connections to trunk lines leading to distant private 60 branch exchanges. When a subscriber in the tems and particularly to systems in which central office desires to obtain a connection with another subscriber local to the same office, he causes the positioning of the registers in accordance with the number of the 65 The object of this invention is the pro- desired line. These registers are then efvision of means, in a system where the selective to control the selective operations of 15 tive switches are operated under the control the switches in the central office to complete of register controlling devices, whereby a the establishment of the connection. When single registration is effective to control a however, a connection is desired with a sub- 70 plurality of selective movements of the scriber's line belonging to a distant private branch exchange, the record set up on the controlling registers causes the group selectprovision of means operable in accordance ing switches shown in Fig. 1 to select a trunk with the selective movement of a switch to leading to one of the special switches in the 75 produce a registration corresponding to such central office. This switch is then operated movement, and which means is thereupon under the control of the tens register to se-25 effective to control the selective movement of lect a level of trunks outgoing to the desired private branch exchange. The movement of the special switch, in the selection of the de- 80 sired level of the trunks, determines the setting of a register associated with such release of the switches, for simultaneously switch in accordance with the registration rendering selectable both ends of the trunk which controls the switch in its selection of the level of outgoing trunks. By this means 85 the tens registration, which determines the selection of the proper level of trunks outgoing to the private branch exchange, is reproduced on the register individual to the switch. The switch, after having chosen the 90 proper level of trunks, operates automatically to select an idle trunk in the level leading to the final connecting switch in the Fig. 1 illustrates diagrammatically a private branch exchange. This final congroup selector switch and a register con-necting switch is then operated under the 95 trolling mechanism. Fig. 2 shows a selective control of the individual register to select a switch in the central office having access to level of subscribers' lines. After having se-45 trunk lines outgoing to a distant private lected the proper level of lines, the final switch in the private branch exchange is then operated under the control of the units 100 register of the register controlling mechanism in the central office to complete the connection to the called line.

The selective switches used in this system and the register controlling mechanism for 105 controlling said switches may be of the type

shown and described in the patent to Polinkowsky No. 1,365,269, granted January

11, 1921.

In the following detailed description of 5 the operation of the system it is assumed that a subscriber whose line terminates in the central office, desires to hold a conversation with a subscriber whose line belongs to a distant private branch exchange, as for 10 example, the subscriber at substation 300. In any well-known manner the calling sub-proper set of brushes. scriber's line is extended by way of conductors 101 and 102 to a first group selector switch whose brushes are shown at 109, 15 110 and 111. In the manner described in the above application of Polinkowsky, a controlling circuit switch 100 for the first group selector switch advances its contacts 103 and 104 into position to extend the call-20 ing line by way of conductors 115 and 116 to an idle register controlling mechanism. The calling subscriber then operates his impulse transmitter to position the registers 130, 140 and 150, in accordance with the

25 called line designation. Since the call is one intended for a subscriber's line in the distant private branch exchange, the brushes of the first group selector 109, 110 and 111 are operated under 30 the control of register 130 to select the terminals 112, 113 and 114 of a trunk leading to the special switch in the central office. When the test brush 111 encounters the test terminal 114, a circuit is completed from 35 battery, winding of relay 243, contact 240 (1) of sequence switch 250, terminal 114, brush 111, contact 108 of sequence switch 100, right-hand high resistance winding of test relay 107 to ground. In parallel to this 40 circuit a circuit is also completed from battery through resistance 242, contact 241, contact 240 (1), to ground through the winding of relay 107. Relay 107 energizes and closes a low resistance path to ground 45 through its left-hand low resistance winding and contact and armature. Relay 243 becomes energized and closes a locking circuit for itself over its left-hand armature and contact, independent of sequence switch 50 contact 240. At the same time the brushes 109 and 110, by making engagement with terminals 112 and 113 respectively, close the fundamental circuit for controlling the brush tripping operation of the switch. 55 This circuit may be traced from battery through the winding of relay 252, contact 244 (1 to 2), terminal 113, brush 110, contact 106, conductor 117, winding of stepping relay 126, armature and contact of relay 125, contact 122 of sequence switch 120, closed in 109, terminal 112, contact 245 (1 to 2) to gization of relay 252 and causes the shuntground. Relay 252 becomes energized and ing of stepping relay 126. Relay 126, by

armature and front contact, contact 253 (1), 65 winding of sequence switch 250 to battery and ground. Sequence switch 250 advances from position 1 into position 2. In position 2 of sequence switch 250 a circuit is closed from battery through the winding of trip 70 spindle power magnet 248, contact 253 (2 to 4), front contact and armature of relay 252 to ground. The power magnet 248 causes the rotation of the trip spindle to select the

When the trip spindle is in its home position the interrupter brush 230 engages the comparatively deep notch 233. The notch 233 is so formed with respect to the remaining notches on the trip spindle element that 80 brush 230 and contact spring 231 remain in engagement with each other at all times while the trip spindle is away from its normal position. The contact springs 231 and 232 are so disposed that they engage each 85 other only during the time that the interrupter brush 230 is passing from one to another of the comparatively shallow notches in the trip spindle element. These shallow notches, of which there are ten, correspond 90 to the brush tripping positions of the switch.

At the time the sequence switch 120 of the register controlling mechanism reached position 10 prior to the closure of the fundamental circuit, a cuircuit was established 95 from ground through contact 124, armature and contact of relay 126, left-hand winding of relay 127, armature and contact of relay 127, contact 123 (10), contact 142 of the tens register 140 through the winding 100 of said register to battery and ground. A circuit was also completed from battery through the right-hand winding of relay 127 to ground at contact 124. Relay 127, being differential, is not operated when both 105 its windings are energized simultaneously. The register 140, however, becomes energized and moves from the position to which it was adjusted by the calling subscriber's transmitter to the next succeeding position. 110 When the master contact 141 of register 140 closes between positions, the left-hand winding of relay 127 is shunted out, permitting this relay to energize over its right-hand winding. When the fundamental circuit is 115 closed, as above described, the stepping relay 126 becomes energized and opens the circuit of the right-hand winding of differential relay 127. Relay 127 thereupon deenergizes. As the brush tripping spin- 120 dle leaves its normal position, a circuit is closed from battery through the winding of relay 252, contact 249 (2), conductor 234, contacts 232 and 231, and brush 230 to position 10, conductor 118, contact 105, brush ground. This circuit maintains the ener- 125 closes a circuit from ground through its releasing its armature, closes the above-

140 to its next succeeding position. This gages the home contact 269 to open the operation continues, the register 140 ad- above-traced circuit for relay 262. The vancing one position for each deenergiza- brush carriage, in moving away from its tion of stepping relay 126 until said reg- normal position, causes the tripping of the ister reaches its normal position 0. In po-selected set of brushes 282, 283 and 284. Re- 70 sition 0 of register 140 a circuit is closed lay 262, by deenergizing, opens the locking from battery through the winding of se- circuit of relay 263. Relay 263 releases its quence switch 120, contact 121 (10), con- armatures and opens the circuit of power 10 tact 143 (0), contact 123 (10), contact and magnet 261 causes the brush carriage to armature and left-hand winding of relay stop. Relay 263 also completes a circuit 75 127, contact and armature of relay 126, from battery through the winding of relay contact 124 to ground. In parallel to this 252, contact 244 (3 to 4), back contact and circuit, a circuit is also completed for the left-hand armature of relay 263, contact 15 relay 125. Relay 125 operates to open the 231, interrupter brush 230 to ground. Refundamental circuit and sequence switch lay 252 becomes energized and completes a 80 120 passes from position 10 into position circuit from battery through the winding 12. As soon, after the fundamental circuit of the trip spindle power magnet 248, conis opened at the register controlling mecha- tact 253 (2 to 4), front contact and arma-20 nism, as contacts 231 and 232 are opened, ture of relay 252 to ground. The trip spintion of the armature of relay 252 opens the cuit and rotates forward to its normal pocircuit of power magnet 248 and also closes sition. It will be noted that since the trip 25 ing sequence switch 250 out of position 2 tions, it will pass through a number of posi-30 setting of the tens register 140. The prin- switch. For example, if the tens digit is 6, 35 the British patent issued to Western Electric these complementary positions, serves to October 5, 1921.

tion 3, a circuit is completed from battery of the final switch in the private branch 40 through resistance 242, contact 241, contact exchange, in accordance with the tens digit. 240 (3 to 4), contact 269, brush 235, winding When the contacts 231 and 232 are first 105 of relay 262 to ground. Relay 262 energizes closed in the restoration of the tripping in this circuit. While sequence switch 250 spindle, a circuit is completed from battery is passing through position $2\frac{1}{2}$ a circuit is through the winding of register 290, con-45 closed from battery through the winding of tact 258 (3), left-hand winding and back relay 263, contact 245 (2½) to ground. The contact and armature of relay 259, contact 110 contact 245 does not open when passing out 257 (3), conductor 234, contacts 232 and of position 2½ until after contact 240 has 231, to ground. In parallel to this circuit, closed in position 3 to permit the energiza- a circuit is also completed from battery tion of relay 262, hence with relays 262 and through the winding of coil 236, right-hand 263 simultaneously energized, a locking cir- winding of relay 259, contact 266 (3), and 115 of relay 263, front contact and right-hand operate when both of its windings are enarmature of said relay, front contact and ergized simultaneously. Register 290, how-60 carriage power magnet 261, front contact winding of relay 259. Relay 259 thereupon brush carriage away from its normal brush 230 drops into the next shallow notch,

traced circuit for advancing the tens register position whereupon the brush 235 disen-65 relay 252 becomes deenergized. The retrac- dle power magnet 248 energizes in this cir- 85 a circuit including contact 254 (2) for driv-spindle is provided with ten tripping posiand into position 3. The tripping spindle tions in its restoration to normal, which is 90 has thus been rotated to a position for trip- the complement of the tens digit that serves ping the set of brushes having access to the to determine the selection of the proper set desired level of trunks as determined by the of brushes 282, 283, and 284 of the selective ciple by which the registers 130, 140 and 150 the trip spindle in rotating from this posi- 95 of controlling mechanisms of this type are tion to position zero covers four positions, set in positions corresponding to the com- the complement of 6. As will now be deplements of the digits, is fully explained in scribed, the trip spindle in passing through Company, Limited, No. 146,517, accepted cause the setting of the individual register 100 290 in a position where it is later effective When sequence switch 250 reaches posi- to determine the brush-selecting operation cuit is completed as follows, for the latter of thence to ground at contacts 231 and 230. these relays: battery, through the winding The relay 259 being differential, does not armature of relay 262, contact 254 (3 to 4), ever, becomes energized and advances from 120 back contact and armature of relay 252 to position 0 into position 1. In passing from ground. A circuit is now established from position 0 to position 1, the master contact battery through the winding of brush 291 closes and short-circuits the left-hand and left-hand armature of relay 263, con- operates by means of current flowing 125 tact 231, interrupter brush 230 to ground. through its right-hand winding. When Magnet 261 energizes and moves the contacts 232 and 231 again open as the

relay 259 is opened to permit the release of this relay. The next closure of contacts 232 and 231 completes the above-traced cir-5 cuit for register 290, which advances from position 1 into position 2. This operation continues until the trip spindle reaches its normal position at which time the interrupter brush 230 engages the comparatively 10 deep notch 233. This causes the separation of contact 231 and brush 230, and the consequent opening of the circuit of relay 252. ground. Relay 360 energizes and completes Relay 252, by releasing its armature opens the circuit of trip spindle power mag-15 net 248.

Relay 252 by deenergizing also completes a circuit from battery through the winding of brush carriage power magnet 261, back contact and armature of relay 262, contact 20 254 (3 to 4), back contact and armature of relay 252 to ground. Power magnet 261 energizes and causes the rotation of brushes 282, 283 and 284, over the selected level of trunks in search of an idle one thereof. The 25 engagement of test brush 284 with test terminal 288 of an idle trunk, which is through the winding of cut-off relay 287, position 5 into position 6. In position 6 terminal 288 brush 284, contact 277 (3), of sequence switch 250, relay 252 is enerleft-hand high resistance winding of test gized in a circuit from battery through the 95 relay 264, to ground. Relay 264 becomes winding of said relay, contact 249 (6), back energized and completes a substitute low contact and armature of relay 259, armature resistance circuit through its right-hand and contact of relay 279, right-hand armawinding, contact and armature and the ture and contact of relay 243, contact 274 winding of relay 262 to ground. This low (5 to 14) to ground. The source of alternat- 100 resistance path serves to reduce the po- ing current 237 is disconnected at contacts tential on the multiples of terminal 288 to 267 and 268 to permit the deenergization of render the selected trunk busy to other relay 373. Relay 373 opens the circuit of 40 switches. Relay 262 energizes and opens the relay 360 which in turn deenergizes and circuit of the power magnet 261 to stop the closes a circuit from battery through the 105 brush carriage. Relay 262 also completes winding of sequence switch 350, contact 356 a circuit from battery through the winding (2), back contact and armature of relay of sequence switch 250, back contact and 360 to ground. Sequence switch 350 moves 45 right-hand armature of relay 263, front from position 2 into position 3. In position contact and armature of relay 262, contact 3 of sequence switch 350, relay 372 is ener- 110 254 (3 to 4), back contact and armature of gized by means of a circuit closed at conrelay 252 to ground. Sequence switch 250 tact 341 (3 to 8). Relay 372 attracts its passes through position 4 and into position 5. armatures and completes a circuit from

50 Since it may be desirable to use the trunk battery through the winding of relay 352, sible. To accomplish this the sequence winding of relay 279, contact 267 (6 to 13), from the source of alternating current 237, hand armature and front contact of relay contact 268 (5), brush 283, terminal 286, con-372, contact 345 (3 to 8) to ground. Relay ductor 301 right-hand armature and back 279 energizes in this circuit and opens the 60 contact of relay 372, left-hand winding of holding circuit of relay 252. Relay 252 relay 373, condenser 303, resistance 375, releases its armature and completes a cir- 125 back contact and left-hand armature of re- cuit including contact 254 (6) for driving lay 372, conductor 302, terminal 285, brush sequence switch 250 out of position 6 and 282, contact 267 (5), winding of relay 260, into position 7.

a circuit for the right-hand winding of to battery and ground. Relay 260 is mar- 65 ginal and does not operate in series with resistance 375 and condenser 303. Relay 373 in the private branch exchange, however, attracts its armature and closes a locking circuit for itself from battery through re- 70 sistance 304, contact 331 (1), right-hand winding and contact and armature of relay 373, to ground. Relay 373 establishes a circuit from ground through its armature and contact, winding of relay 360, to battery and 75 a circuit from battery through the winding of sequence switch 350 contact 354 (1), front contact and armature of relay 360. to ground, for moving this sequence switch into 80 position 2. Sequence switch 350, in leaving position 1, opens the test conductor 305 at contact 341, to render the trunk non-selectable by switches in the private branch exchange. In position 2 of sequence switch 85 350, condenser 303 and resistance 375 are shunted at contact 342. Relay 260 new becomes energized and completes a circuit from battery through the winding of sequence switch 250, contact 253 (5), front 90 identified by the presence of a full battery contact and armature of relay 260 to potential, closes a circuit from battery ground. Sequence switch 250 advances from lines interconnecting the central office and contact 344 (3 to 8) front contact and right- 115 the private branch exchange, as two-way hand armature of relay 372, conductor 301, trunks, it is necessary to render the distant terminal 286, brush 283, contact 268 (6 to end of the trunk line busy as soon as pos- 13), contact and armature of relay 272, switch 250 in position 5, completes a circuit brush 282, terminal 285, conductor 302, left-120

With sequence switch 250 in position 7 and the register controlling sequence switch 120 in position 12, the units controlling position, the fundamental circuit is closed as herein-5 before described. Relay 252 attracts its armature and complete a circuit including contact 253 (7), for driving sequence switch 250 out of position 7 and into position 8. Between positions 7 and 8 of sequence switch 10 250, a circuit is momentarily closed from battery through the winding of relay 272, contact 256 (8 to 10), master contact 238 of the master contact 291 short-circuits the leftsequence switch 250 to ground. Relay 272 hand winding of relay 259 to permit said reremains energized until the sequence switch lay to energize. This operation continues 15 250 reaches position 8. The energization of until the register 290 has been restored to its 80 relay 272 opens the above-traced circuit for normal position 0, at which time the trip relays 352 and 279, permitting these relays spindle of the final switch will have adto release their armatures. In position 8 vanced to a position for tripping the set of of sequence switch 250 and after the release brushes having access to the desired group 20 of the armature of relay 279, a circuit is of subscribers' lines. As soon, after the reg- 85 closed from battery through the winding of ister 290 reaches position 0, as relay 279 recoil 236, right-hand winding of relay 259, leases its armature, a circuit is established contact 266 (8), armature and contact of relay 279, right-hand armature and contact 25 of relay 243, contact 274 (5 to 14) to ground. This circuit is closed slightly before the contact 258 closes in position 8. The differential relay 259, therefore operates and remains energized to prevent the disturbance 30 of register 290 until relay 279 again energizes to open the circuit through the righthand winding of relay 259.

the energization of relay 272 in the central 35 office, a circuit is completed from battery through the winding of sequence switch 350, contact 353 (3), back contact and armature of relay 352 to ground. Sequence switch 350 moves from position 3 into position 4. With sequence switch 250 in position 8 and relay 272 deenergized, the above-traced circuit is closed for the energization of relays 352 and 379. Relay 352 completes a circuit from ground through its armature and front contact, contact 347 (4), through the winding of trip spindle power magnet 348, to battery and ground. The trip spindle power magnet energizes and causes the rotation of the trip spindle in the well-known 50 manner. When relay 279 energizes, with sequence switch 250 in position 8, the circuit through the right-hand winding of relay 259 is opened causing this relay to deener- 361 causes the rotation of the brush carriage gize. As the brush-tripping spindle of the to advance the selected set of brushes 332, 55 final connecting switch in the private branch 333 and 334 into engagement with the termi- 120 exchange approaches its first brush-tripping nals of the called line 300. For each set of position, contacts 355 and 357 are closed to line terminals passed over by the brushes, complete a circuit including contact 349 (4 a circuit is closed from battery through the to 6), for shunting out relay 279. Relay 279 winding of relay 352, contact 349 (4 to 6), 60 by retracting its armature completes a cir- interrupter brush 306, to ground. This cir- 125 cuit from battery through the winding of cuit maintains the energization of relay 352 register 290, one of the two contacts 293 or but causes the shunting of relay 279 in the 294 of register 290 dependent upon the posi- central office. Upon the first deenergization in which said register is standing, con-tion of relay 279, a circuit is completed from 65 tact 258 (8), left-hand winding and back battery through the winding of relay 252, 130

contact and armature of relay 259, armature and contact of relay 279, right-hand armature and contact of relay 243, contact 274 (5 to 14), to ground. In parallel to this circuit, a circuit is also completed from bat- 70 tery through the winding of coil 236, righthand winding of relay 259, contact 266 (8). and thence to ground at contact 274. The differential relay 259 remains inoperative whereas register 290 energizes and advances 75 one position. In passing between positions from battery through the winding of sequence switch 250, contact 292 (0) of register 290, contact 258 (8), left-hand winding 90 and back contact and armature of relay 259, armature and contact of relay 279, righthand armature and contact of relay 243, contact 274 (5 to 14), to ground. A parallel circuit is also completed from battery 95 through the winding of relay 272, contact 256 (8 to 10), and thence to ground at con-When relay 352 deenergizes in response to tact 274. Relay 272 operates to open the circuit of relay 352 and sequence switch 250 energizes and moves from position 8 into 100 position 10. The next opening of contacts 355 and 357 after the energization of relay 272, causes the release of relay 352, which completes a circuit from ground through its armature and back contact, contact 353 (4), 105 winding of sequence switch 350 to battery and ground. Sequence switch 350 advances from position 4 into position 6.

When sequence switch 250 leaves position 8, contact 258 is opened to permit the de- 110 energization of relay 272. The above traced circuit including relays 352 and 279 is then closed. Relay 352 attracts its armature and completes a circuit from battery through the winding of the brush carriage power magnet 115 361, contact 346 (6), front contact and armature of relay 352 to ground. The magnet

10 units register 150 in the manner described ground through the armature and back con- 75 in connection with the tens register 140. contact and armature and left-hand winding switch 350 opens at its contact 341, the hold-so of relay 127, contact and armature of relay 126, to ground at contact 124. For each sucrelay 279 deenergizes to in turn cause the 20 energization of the stepping relay 126 to cause the advance from position to position of the units register 150. When register 150 reaches its 0 position, which determines that the brushes 332, 333 and 334 have reached 25 the terminals 335, 336 and 337 of the called line, a circuit is completed from battery through the winding of sequence switch 120, contact 121, contact 153 (0), contact 123 (12), contact and armature and left-hand 30 winding of relay 127, contact and armature of relay 126, contact 124, to ground. The sequence switch 120 advances to its next po-As soon, after the energization of relay 125, fore sequence switch 250 reaches position 13, 100 40 contact and armature of relay 252 to ground. With sequence switch 350 in position 10 105 Relay 272 opens the circuit of relay 352 tery and ground for moving said sequence 110 and completes a circuit from battery through terminal 336, over the loop of the called line, 115 sequence switch contact 256 open in position from the switchhook, the marginal relay 360 120 again complete a circuit for the energization a circuit from battery through the winding of relays 352 and 279.

60 through position 7, a test is made to deter- relay 360. Sequence switch 350 is moved 125 mine the busy or idle condition of a called from position 12 into position 14. Sequence line. Assuming the line to be idle, full po-switch 350, in leaving position 12, opens the tential is found on terminal 337 and a cir- circuit of relay 360 which thereupon deenercuit is closed from battery through the wind-gizes. In positions 13 to 18 of sequence

contact 249 (10 to 13), back contact and contact 359 (7), left-hand high resistance armature of relay 259, armature and contact winding of relay 364 to ground. Relay 364 of relay 279, right-hand armature and con-energizes and closes a substitute circuit tact of relay 243, contact 274 (5 to 14), to through its low resistance right-hand wind-5 ground. This circuit maintains the energi- ing and front contact and armature to 70 zation of relay 252 but causes the shunting ground. This low resistance path decreases of the stepping relay 126 in the fundamental the potential on terminal 337 to render the circuit. Relay 126 by retracting its arma-called line busy. In position 8 of sequence ture closes a circuit for the advance of the switch 350 a circuit is completed from tact of relay 360, contact 356 (8), winding of This circuit may be traced from battery sequence switch 350 to battery and ground through the winding of register 150, contact for driving sequence switch 350 into posi-152, contact 123 (12) of sequence switch 120, tion 10. In leaving position 8, sequence ing circuit of relay 372. This relay, however, is energized in a circuit including conceeding closure of the interrupter brush 306, tact 356 (9 to 10) and the back contact and armature of relay 360. In passing from position 8 to 10, sequence switch 350 opens 85 its contacts 344 and 345 to cause the momentary deenergization of relays 352 and 279. Relay 279 by retracting its armature completes a circuit from battery through the winding of relay 252, contact 249 (10 to 13), 90 back contact and armature of relay 259, armature and contact of relay 279, righthand armature and contact of relay 243, contact 274 (5 to 14), to ground. Relay 252 becomes energized and completes a circuit 95 from ground through its armature and front contact, contact 253 (12 to 13), winding of sition while relay 125 is energized as above sequence switch 250, to battery and ground. described to open the fundamental circuit. Sequence switch 250 leaves position 12. Beas relay 279 becomes energized, relay 252 however, relay 279 becomes energized in releases its armature and completes a cir- series with relay 352 and opens the circuit of cuit from battery through the winding of relay 252. Relay 252, therefore, deenergizes sequence switch 250, contact 254 (10), back and sequence switch 250 stops at position 13.

A circuit is also completed from battery and relay 352 energized, a circuit is comthrough the winding of relay 272, contact pleted from ground through the armature 256 (8 to 10), contact 254 (10), back con- and front contact of relay 352, contact 353 tact and armature of relay 252 to ground. (10), winding of sequence switch 350 to batwhile sequence switch 250 energizes and switch into position 12. In position 12 ringmoves into position 12. As soon, after the ing current is applied to the called line by energization of relay 272, as the interrupter means of a circuit traceable from the ringbrush 306 is opened relay 352 deenergizes ing source 320, contact 366 (12), brush 333, the winding of sequence switch 350, contact and returning by way of terminal 335, brush 353 (6), back contact and armature of relay 332, contact 367 (12), winding of relay 360 352 to ground. Sequence switch 350 passes to battery and ground. When the called from position 6 into position 8. With the subscriber responds by removing his receiver 12, relay 272 is permitted to deenergize and is energized in the usual manner and closes of sequence switch 350, contact 354 (12), to While the sequence switch 350 is passing ground at the front contact and armature of ing of relay 371, terminal 337, brush 334, switch 350, relay 372 is maintained ener- 130

1,459,186

gized in a circuit including sequence switch above-traced circuit for relay 360 is again 5 279 and 352. Relay 279 releases its arma- cuit including contact 354 (16) for moving 70 contact, contact 253 (13), winding of se- 361, contact 346 (17), back contact and arma-10 quence switch 250 to battery and ground. ture of relay 352 to ground. The brush car- 75 15 and 363 closed in position 14, a through cir- to ground. Relay 352 opens the circuit of 80 20 the supervisory relay 368 is energized in se- Sequence switch 350 moves into position 18. 85 ries therewith.

After the conversation has been com-25 release of the first group selector switch in becomes energized in a circuit from battery 250 into position 18. idle.

exchange. A circuit is then closed from trunk are simultaneously released. battery, through the winding of relay 360. With sequence switch 250 in position 18 a resistance 321, contact 376 (14), contact and circuit is closed from battery through the armature of relay 368, back contact and winding of brush carriage power magnet 55 armature of relay 352 to ground. Relay 261, back contact and armature of relay 262, 120 360 becomes energized and closes a circuit contact 254 (18), back contact and armature from battery through the winding of se- of relay 252 to ground. The brush carriage quence switch 350, contact 354 (14), front commences to rotate and on reaching its norcontact and armature of relay 360, to mal position, a circuit is closed from batground. Sequence switch 350 advances tery through resistance 242, contact 241 125 from position 14 into position 15. Relay (18), contact 240 (18), contact 269, brush 360 releases its armature and completes a 235, winding of relay 262 to ground. Relay circuit including contact 356 (15), for driv- 262 becomes energized and opens the circuit ing sequence switch 350 out of position 15 of magnet 261 to stop the brush carriage. and into position 16. In position 16, the Relay 262 also establishes a circuit from bat- 130

contact 341. When sequence switch 350 closed through contact 376, and the contacts leaves position 12, contacts 344 and 345 are and armatures of relays 368 and 352. Relay opened to cause the deenergization of relays 360 becomes energized and completes a cirture and completes the above-traced circuit sequence switch 350 into position 17. A cirfor relay 252. Relay 252 completes a circuit cuit is now closed from battery through the from ground through its armature and front winding of brush carriage power magnet Sequence switch 250 advances into position riage commences to rotate and on reaching 14 which is the talking position. With se- its normal position, a circuit is completed quence switch contacts 246 and 247 closed in from battery, through the winding of relay position 14, and sequence switch contacts 367 352, contact 378 (17), contact 322, brush 323 cuit is established from the first group se- power magnet 361 and also completes a cirlector, shown in Fig. 1, to the called sub- cuit from battery, through the winding of scriber's line. Talking battery is supplied in sequence switch 350, contact 353 (17), front the usual manner from the central office and contact and armature of relay 352 to ground. In position 18 of sequence switch 350, a circuit is established from battery, through the pleted, the calling subscriber, by replacing winding of relay 352, contact 344 (18), thence his receiver on the switchhook, causes the over the trunk conductor as hereinbefore traced, through the winding of relay 279, 90 the well-known manner. The test brush 111 and returning to ground at contact 345 (18). by disengaging test terminal 114, opens the Relays 352 and 279 become energized. Reholding circuit of relay 243. Relay 243 re- lay 352 by attracting its armature, closes a leases its armatures and completes a circuit circuit including sequence switch contact from battery through the winding of se- 353 for driving sequence switch 350 out of 95 quence switch 250, make-before-break con-position 18 and into position 1. The relay tact of relay 243, contact 274 (5 to 14) to 279 by attracting its armature, opens the ground. Sequence switch 250 thereupon circuit of relay 252. Relay 252 releases its moves from position 14 into position 17. In armature and completes a circuit including 35 position 17 of sequence switch 250, relay 252 contact 254 (17) for moving sequence switch 100

through the winding of said relay, contact It will be observed that sequence switch 249 (17), back contact and armature of relay 350 and sequence switch 250 are advanced 259, armature and contact of relay 279, con-simultaneously from their respective positact 274 (15 to 18) to ground. The reason tions, 18 and 17. Sequence switch 350, by 105 for energizing relay 252 is, as will be pres-moving from position 18 into position 1. ently seen, to hold the sequence switch 250 opens the circuit of relay 372 and closes the from passing out of position 17 to render the contact 341 to render the test terminal 324 outgoing end of the trunk idle until the of the trunk line selectable by switches of switch at the distant end of the trunk has the private branch exchange. The sequence 110 reached the necessary point in its restoration switch 250, in passing out of position 17 for rendering the distant end of said trunk opens its contact 277 to render the test terminal 288 of the trunk line selectable to The opening of the line circuit causes the other switches in the central office. By this 50 release of relay 368 in the private branch arrangement both ends of the two-way 115

5 of relay 252 to ground. Sequence switch circuit of the power magnet 361 and also 70 250 thereupon advances into its normal posi-closes a circuit including contact 353 (10)

tion 1.

line 300 is busy at the time its terminals are 350, relay 372 remains deenergized to pre-10 tested by the final selector switch. This vent the energization of relay 352 in 75 being the case, a reduced potential exists on ceive sufficient current to attract its armature when sequence switch 350 passes 15 through position 7. Since relay 364 remains deenergized a circuit is closed from battery through the winding of relay 360, resistance 321, contact 376 (7 to 10), back contact and armature of relay 364 to ground. 20 Relay 360 attracts its armature and opens the circuit which would otherwise drive sequence switch 350 out of position 8. Sequence switch 350, therefore, comes to rest in position 8 and contacts 344 and 345 25 remain closed to prevent the momentary deenergization of relay 279. The relay 252 is therefore not energized in the manner above described and sequence switch 250 which has just advanced into position 12, remains in this position. A circuit is thereterrupter 278, contact 239 (12), primary pares a circuit as explained for moving seground. The interrupter 278 causes the 35 impression of a characteristic tone on the calling line which notifies the calling subscriber that the called line is busy. The calling subscriber, replacing his receiver on the switchhook, causes the release of the first group selector and the consequent deenergization of relay 243. Relay 243 closes the circuit hereinbefore traced for advancing sequence switch 250 out of position 12 and into position 17. The opening of contacts 267 and 268 as sequence switch 250 leaves position 13, causes the deenergization of relay 352. Relay 352 completes a circuit from ground through its armature and back contact, and contact 353 (8) for driving sequence switch 350 into position 10. In position 10 of sequence switch 350, relay 360 is energized by means of a circuit closed through contact 367 and the back contact and armature of relay 364. Relay 360, at its 55 armature and back contact, opens the holding circuit of relay 372. Relay 372 releases its armatures to prevent the closure of the energizing circuit of relay 352 when sequence switch 250 reaches position 17. Re-60 lay 352, therefore, remains deenergized and a circuit is completed from battery through the winding of brush carriage power magnet 361, contact 346 (10), back contact and armature of relay 352 to ground. The

65 brush carriage rotates and on reaching its

tery through the winding of sequence switch home position, a circuit is closed from bat-250, back contact and armature of relay 263, tery through the winding of relay 352, confront contact and armature of relay 262, tact 378 (10), contact 322, brush 323 to contact 254 (18), back contact and armature ground. Relay 352 operates and opens the for moving sequence switch 350 into posi-It will now be assumed that the called tion 12. In position 12 of sequence switch series with relay 279. The relay 368 being test terminal 337 and relay 364 does not re- deenergized, however, a circuit is closed as above described, for the energization of relay 360, including contact 376, contact and armature of relay 368 and the back contact 80 and armature of relay 352. Relay 360 completes a circuit including contact 354 (12) for moving sequence switch 350 into position 14. In position 14, relay 372 is again energized by means of a circuit closed at 85 contact 341 (13 to 18). Contacts 344 and 345, being open in this position however, relay 352 is still unable to energize in series with relay 279. Relay 360 is again energized in the circuit traced and closes the 90 circuit including contact 354 (14), for driving sequence switch 350 into position 15. In position 15 relay 360 deenergizes and completes a circuit including contact 356 for driving sequence switch 350 into posi- 95 upon closed from ground through the in-tion 16. Relay 360 again energizes and prewinding of the tone coil 276, to battery and quence switch 350 into position 17. In position 17 relay 352 is again energized in a circuit over contact 378, contact 322, brush 323. 100 Relay 352 completes a circuit including contact 353 (17), for moving sequence switch 350 into position 18. In position 18 of sequence switch 350, relay 352 becomes energized in series with relay 279 and from this 105 point on the remainder of the disconnection takes place as hereinbefore described.

The private branch exchange disclosed in this system is assumed to have a capacity sufficiently large to utilize several levels of 110 trunks in the switch at the central office. Accordingly positions 4 and 9 of the individual register 290 are assigned to the establishment of connections to this particular private branch exchange. The remaining posi- 115 tions from 0 to 3 of register 290, in which positions contacts 220 and 221 are closed. may be assigned to the establishment of connections to a smaller private branch exchange requiring a comparatively few levels 120 of trunks in the switch.

What is claimed is:

1. In a telephone exchange system, a telephone line, a selective switch, a second selective switch, a plurality of switch- 125 controlling registers, means controlled in accordance with the setting of one of said controlling registers for operating said first switch to extend the telephone line to said second switch, and means operated in ac- 130

cordance with the extent of operation of operating said second switch to extend the said first switch for controlling the opera- telephone line. tion of said second switch to further extend 6. In a telephone exchange system, a tele-

10 registers for operating said first switch to brush-selecting element to select a set of 75 15 said second switch, and means controlled in tent of operation of said brush-selecting 80 lectively operating said second switch to the telephone line. extend the telephone line.

phone line, a selective switch, a second se- brushes and a brush-selecting element, a lective switch, a plurality of switch second selective switch, a plurality of controlling registers, means controlled in switch-controlling registers, means conaccordance with the setting of one of said trolled in accordance with the setting of one 25 registers for operating said first switch to of said registers for operating said brush- 90 extend the telephone line to said second selecting element to select a set of brushes. switch, an additional register, means for means for operating the selected brushes setting said additional register in accord- of said first switch to extend the telephone ance with the extent of operation of said line to said second switch, means for refirst switch, and means controlled in accord- storing said brush-selecting element to its 95 ance with the setting of said additional rec- normal position, and means operated in reister for selectively operating said second sponse to the restoration of said brush-

35 phone line, a selective switch, a second se-further extend the telephone line. lective switch, a plurality of switch- 8. In a telephone exchange system, a secontrolling registers, means controlled in lective switch, a trunk line, a second seaccordance with the setting of one of said lective switch, means for operating said registers for operating said first switch to first switch to extend a connection over said 40 extend the telephone line to said second trunk to said second switch, means for oper- 105 switch, an additional register individual to ating said second switch to further extend said first switch, means for setting said ad- said connection, means for rendering said ditional register in accordance with the trunk busy at said first switch, means for extent of operation of said first switch, and rendering said trunk busy at said second means controlled in accordance with the switch, means for releasing said switches, 110 setting of said additional register for se- and means operated during the release of lectively operating said second switch to said switches for removing the busy condi-

5. In a telephone exchange system, a tele-taneously. 50 phone line, a selective switch, a second se- 9. In a telephone exchange system, a tele- 115 55 extend the telephone line to said second brushes, means for operating the selected 120 lectively operating said second switch, said telephone line. last means being also controlled in accord- 10. In a telephone exchange system, a

the telephone line. phone line, a selective switch having 2. In a telephone exchange system, a tele-brushes and a brush-selecting element, a 70 phone line, a selective switch, a second se- second selective switch, a plurality of lective switch, a plurality of switch-switch-controlling registers, means concontrolling registers, means controlled in trolled in accordance with the setting of accordance with the setting of one of said one of said registers for operating said extend the telephone line to said second brushes, means for operating the selected switch, means operated in accordance with brushes of said first switch to extend the the extent of operation of said first switch telephone line to said second switch, and for controlling the selective operation of means operated in accordance with the exaccordance with the setting of another of element for controlling the selective operasaid controlling registers for further se- tion of said second switch to further extend

7. In a telephone exchange system, a tele-3. In a telephone exchange system, a tele-phone line, a selective switch having 85 switch to further extend the telephone line. selecting element for controlling the selec-4. In a telephone exchange system, a tele-tive operation of said second switch to

further extend the telephone line.

tion of said trunk at both switches simul-

lective switch, a plurality of switch-phone line, a selective switch having controlling registers, means controlled in brushes and a brush selecting device, a secaccordance with the setting of one of said ond selective switch, means for operating registers for operating said first switch to said brush selecting device to select a set of switch an additional register individual to brushes of the first switch to extend the said first switch, means for setting said ad-telephone line to said second switch, and ditional register in accordance with the ex- means operated in accordance with the extent of operation of said first switch, and tent of operation of said brush selecting demeans controlled in accordance with the vice for controlling the selective operation 125 setting of said additional register for se- of said second switch to further extend the

ance with the setting of another of said telephone line, a selective switch having 65 controlling registers for further selectively brushes and a brush selecting device, a sec- 130 Taran Anna 1916年 1916年 1918年 1918年

land the first the first the contest of the first of the

一点,更是在心理的特别的,我就是他们的一点,但是一点是一点的一点的一点,这个人的一点的,这一点是这个人的一点,这个人的一点。这个人的一点一点,这个人的一点,这

大大型,1000年,1911年,1911年1911年,1911年1911年,1911年1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年

,一个的原理,我们就是有一个人,我们就是有一个人的人的人的人。""我们是一个人的人的,我们就是一个人的人的人的人的人的人。""我们,我们也是一样的人。""我们

[17] "我们就是我们的"我们的"的"我们的"的"我们的",我们就是一个"我们的"的"我们的",我们就是一个"我们的"的"我们"的"我们"的"我们"的"我们" [18] "我们就是我们的","我们们"的"我们"的"我们"的"我们","我们"的"我们"的"我们","我们"的"我们"的"我们"的"我们"的"我们"的"我们"

一个真正的,我就是不是一个人,我们也没有这些的一个人,我们们可以说着一个事情,我们也不是一个人的一个人,我们也不是一个人。""我们,我们都不会不好的。""我们

一定整理的,但是是有一个的。在1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年,1911年

gan 1985年 1986年 1986年

一点的微笑,只有自己说话,我的她们没有一个,一点一点,就是一个一个一点,一点一点,一直,一直被一直的人的一直,他们也不是一个一点,他们就是一个一点,他们就是一个

"我美国共和国国家的人",这是1960年的大型的大型的大型的人。 1961年 1

· "我就是我们的我们的我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们就是我们的。""我们的,我们也不是不是这样的。""我们就是我们的,我们就不会 "我们就是我们我们的我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们就是我们的,我们

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1987年1月1日 - 1988年 - 19

的人类,我们就是我们的人,我们就是我们的人,我们就是这些人的人,我们就是一个人的人,我们就是一个人的人,我们就是一个人的人,这样,我们也不是一个人的人,我们就会 "我们就是我们的,我们们就是我们的,我们就是我们的人,我们就是我们的人,我们就是我们的人,我们就是我们的人,我们就是我们的人,我们就是我们的人,我们就是我们的人

,一句表示,我们的一点,要更是这样的"一句的话,这种话,我们的"我们",这个时间,我们的"好"。"好",这是一个话的"我们"的话,这样的"我们"。"我们"的话

19.11. (新典文· \$14.8) (19.16) (19.16) (19.16) (19.16) (19.16) (19.16) (19.16) (19.16) (19.16) (19.16) (19.16)

为一个_大身,我就没有一定的人们,这一点,我们也没有一个人,我们的这种人们的一点,也不是一个人的人的,我们就会不会的人们的人,我们就是这个人的人。

的现在分词 有一个人,我们还是一个人的人,我们的人,我们就是一个人的人,我们也不是一个人的人,我们也不是一个人的人,我们也不是一个人的人,我们也会会会一个人, 第一个人

and the contract of the constant of the constant state of the constant of the

大型,更加强力,是一种企业,在1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年,1980年

ating the selected set of brushes to extend to further extend the telephone line. 5 the telephone line to said second switch, In witness, whereof, I hereunto subscribe means for restoring the brush selective de- my name this 2nd day of April A D., 1820. vice to its normal condition, and means LIPA POLINKOWSKY.

ond selective switch, means for operating operated in response to the restoration of said brush selecting device to select a set of said brush selecting device for controlling brushes of said first switch, means for oper- the selective operation of said second switch 10