

Aug. 10, 1926.

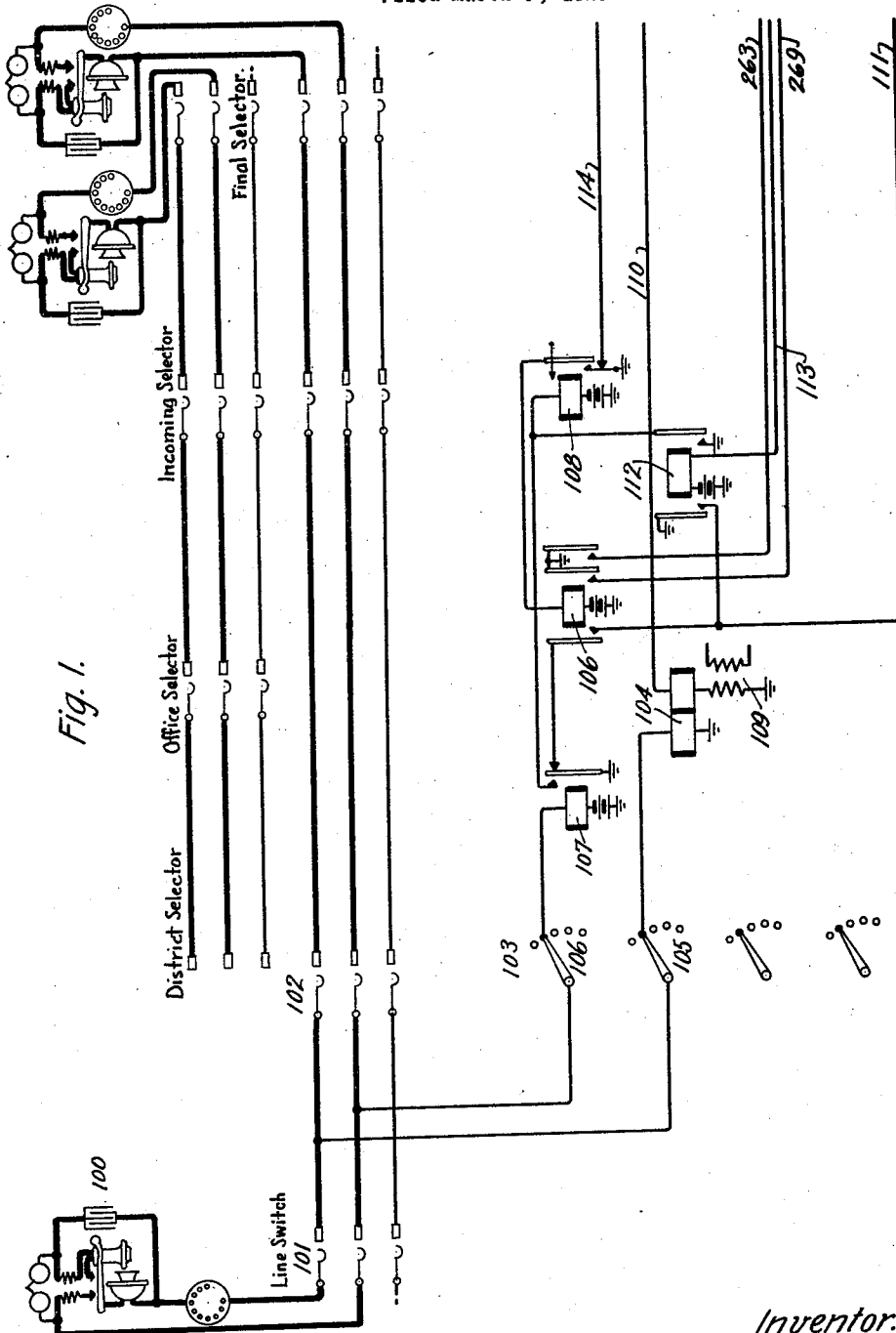
1,595,072

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TELEPHONE EXCHANGE SYSTEM

Filed March 9, 1923

3 Sheets-Sheet 1



Inventor:
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3 Sheets-Sheet 2

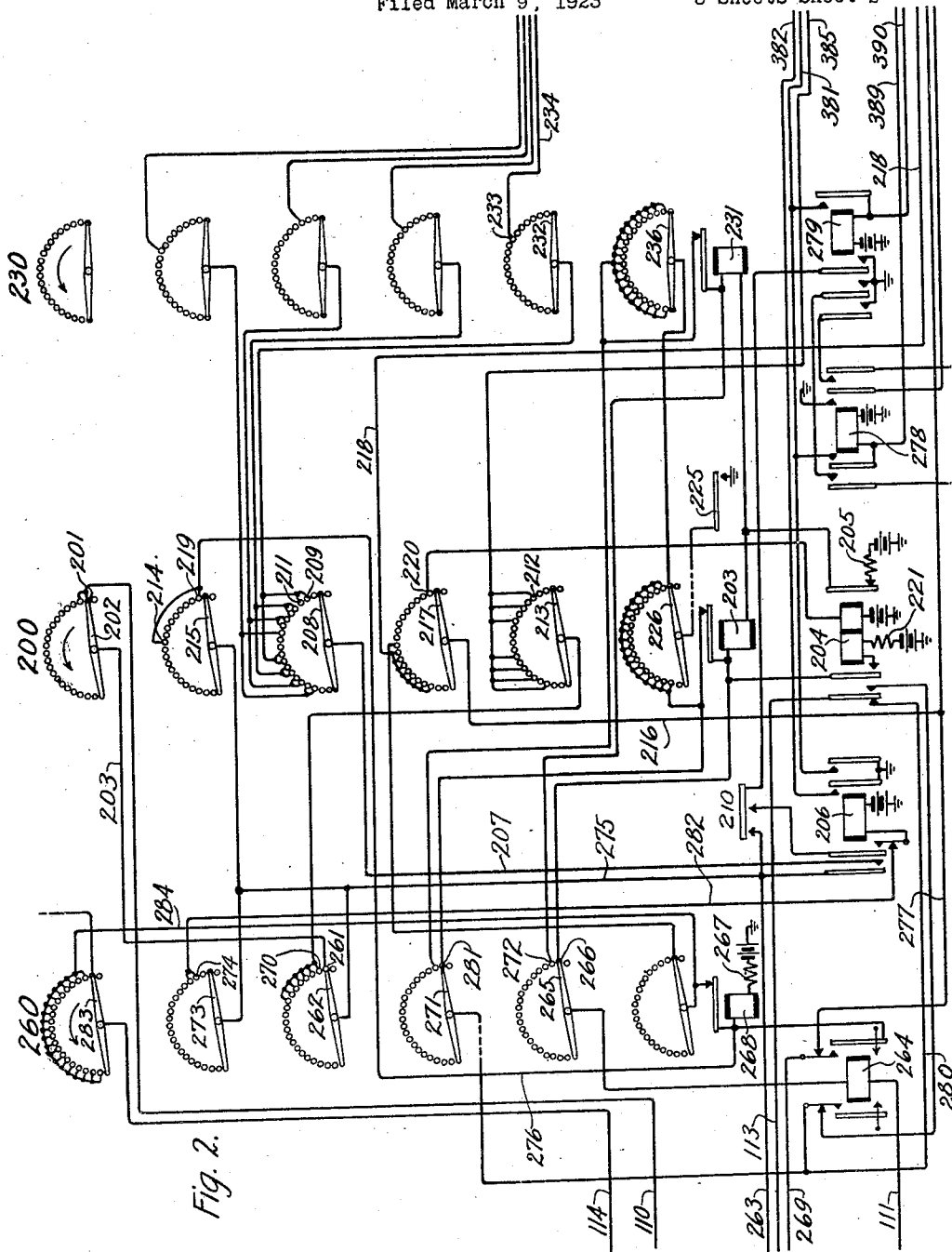


Fig. 2.

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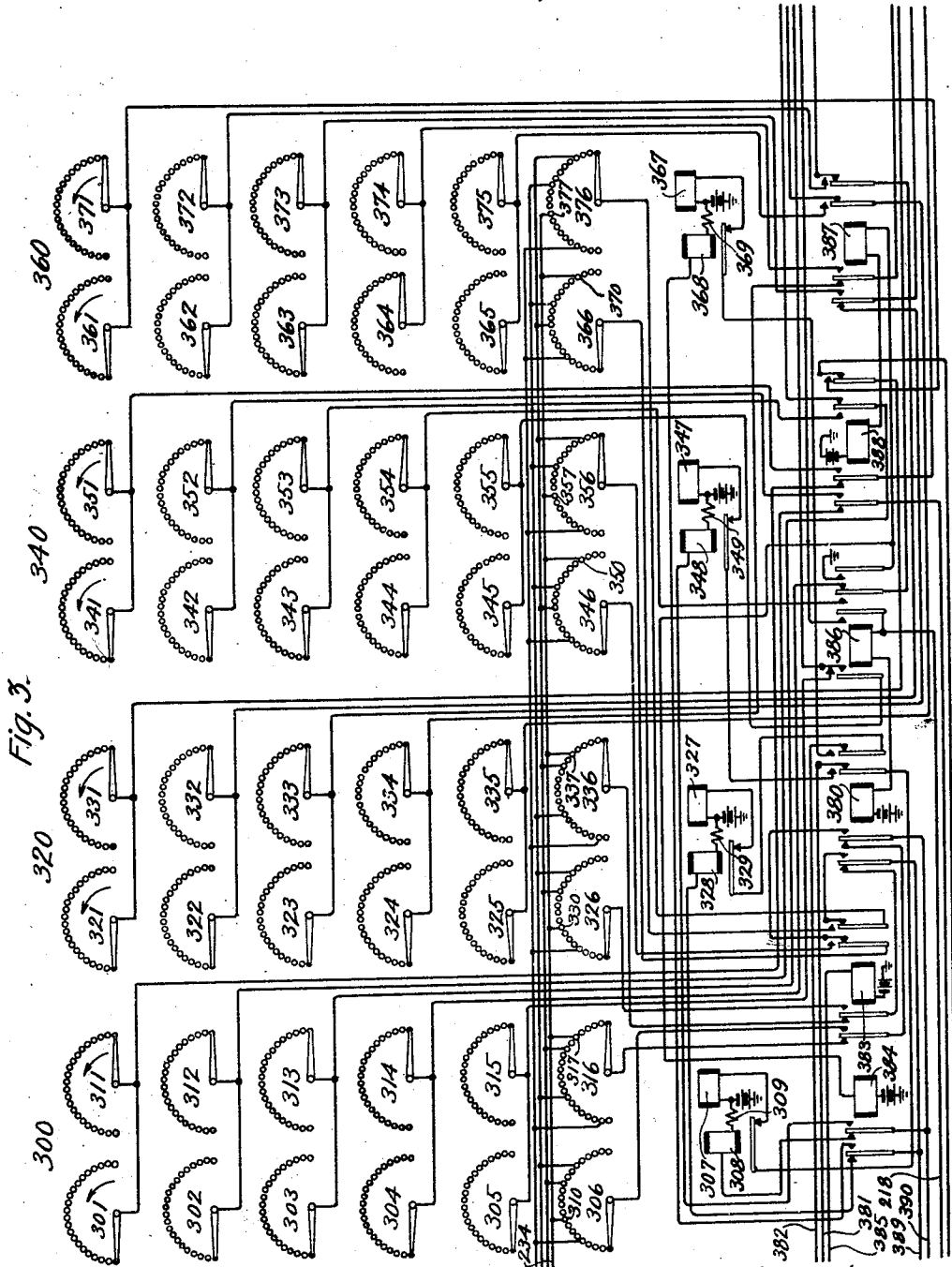
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TELEPHONE EXCHANGE SYSTEM

Filed March 9, 1923

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE.

HARRY C. CAVERLY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE-EXCHANGE SYSTEM.

Application filed March 9, 1923. Serial No. 623,902.

This invention relates to telephone exchange systems employing mechanical switching devices and more particularly to impulse recording and translating devices for such systems.

The number of offices which may be connected by a given exchange system is indicated by the number of digits in the office code. Obviously, a one-digit code would permit selection among not more than 10 offices; a two-digit code among not more than 100 offices; a three-digit code among not more than 1000 offices and so on. In practice these numbers would be decreased by the reservation of the digit 0 for calls to operator and the absorption of a single impulse to avoid false operation due to accident. A further decrease would be caused by the difficulty of finding office names having certain initial combinations of letters. It is thus probable that a one-digit code would serve for 8 offices; a two-digit code for perhaps 50 offices; a three-digit code for possibly 300 offices.

In exchange areas employing a two-digit or a three-digit code, connections are usually established through the intermediation of a sender which records the impulses sent out by the subscriber and then automatically controls the routing of the call and the connection to the called subscriber's line in accordance with this setting of the registers. Not only does the number of the registers increase with the number of digits employed but the complexity of the circuits and apparatus necessary for translating the setting of the code registers increases enormously. In exchange areas, therefore, where the ultimate number of offices does not greatly exceed the capacity of a two-digit system it is highly desirable to find means for increasing that capacity, without being forced to extend the system to a full three-digit basis.

It is the object of this invention to provide a sender which will respond either to a two-digit or a three-digit office code, and at the same time retain the simplicity of the two-digit sender.

In accordance with a feature of the invention, means are provided for recording a plurality of digits on one of the registers

and then translating the combined settings of the several registers.

An additional feature is the use of a registering device arranged to record a variable number of digits, and circuits for accomplishing the discrimination whereby the number of digits to be recorded is determined.

A further feature of the invention is the use of a plurality of translating devices and the method of discriminating between the translators.

Since complete telephone exchange systems of the type to which the sender of the present invention is applicable, have been disclosed in a number of patents and applications, the automatic switches and selecting circuits have been indicated only diagrammatically in the drawing illustrating this application. Reference is made to application for patent of Ottmar H. Kopp, Serial No. 465,294 filed April 28, 1921, issued as Patent No. 1,509,434, Sept. 23, 1924, for a more complete disclosure of such circuits. The invention is, of course, capable of use in other systems than that shown in the drawing.

Referring to the drawing, Fig. 1 shows a calling subscriber's substation. Switches by means of which a connection may be extended to a called substation are diagrammatically indicated, as is a sender selector. The lower portion of the figure shows some of the relays of the sender. Fig. 2 shows the code registers and Fig. 3 shows the translator switches which control district and office selections.

The general operation of the system is substantially similar to that described in the above mentioned Patent No. 1,509,434, issued to O. H. Kopp Sept. 23, 1924. When the calling subscriber at substation 100 removes his receiver from the switchhook, a line switch 101 is put into operation to select a trunk leading to an idle district selector such as 102. The seizure of such trunk puts into operation a sender selector 103 which associates an idle sender with the selected trunk circuit.

Each sender is provided with a plurality of step by step registering devices. These registering devices may be of any desired

character but are preferably of the type shown and described in Patent 1,472,465, granted October 30, 1923, to O. F. Forsberg and R. M. De Vignier. A register controlling switch is utilized to direct the successive series of pulses to the registering devices.

With the regular code the controlling switch directs a single series of pulses to each of the registering devices. When a special code is to be used a preliminary series of pulses of predetermined number is sent out which places the first register in a position in which a circuit is closed for preventing the advance of the register controlling switch at that time. The second series of pulses is then recorded on a different section of the first register. The controlling switch is permitted to advance at the close of this series of pulses to direct the succeeding series to the succeeding register or registers. Any digit may be used as a preliminary digit for the special code, but obviously, it cannot at the same time be used as the first digit of any of the regular codes. It is also obvious that the capacity of any of the registers may be increased in the same way, or that the arrangement may be applied to a system employing any number of registers. Also, more than one digit may be used for the preliminary digit, where flexibility is more desirable than a maximum increase in capacity.

The translator switch is of such simple construction that it has not been necessary to provide a drawing of its mechanism. Two arcuate contact banks each comprising a number of contact sets, and each contact set comprising a plurality of contacts, are arranged side by side and supported by a suitable frame. A brush shaft carrying two brush sets arranged to cooperate with the contact sets is mounted in operative relation to the contact banks in the same frame. The brush sets are 180° apart in rotation, that is, they are diametrically opposite one another on the shaft, and the arrangement is such that when one brush completes its travel over its associated contact bank, the other brush set will begin its travel over its associated contact bank. The power is transmitted to the shaft from a constantly rotating shaft by means of clutch discs controlled in the manner commonly employed in the construction of sequence switches. The power source is indicated in the present disclosure by the magnet 307, 327, 347 or 367. Since the brushes are driven at high speed, a stop magnet represented in the drawing by magnet 308, 328, 348 or 368 has been provided for each translator switch in order to insure the brushes stopping on the desired terminal set. As the number of functions to be controlled by the translator switch exceeds the number of arcs usually

provided on a switch of this type, two switches 300 and 320 are provided and are rotated and stopped simultaneously so that they form in combination essentially one translator. In order to increase the possible number of office registrations, a second pair of translator switches 340 and 360 is provided which are also controlled simultaneously, together with means for discriminating between the pairs of translator switches as will be described later.

The detailed operation of the system is as follows:

When an idle sender is selected and the brush set of the sender selector comes to rest on the terminals leading to the sender, a circuit is completed from ground, left-hand winding of the balancing coil 104, contact and brush 105 of sender selector 103, contact and brush of line switch 101, through the subscriber's substation, brush and contact of line switch 101, brush 106 and contact of sender selector 103, winding relay 107 to grounded battery. Relay 107 operates and closes a circuit from ground at its armature and front contact, winding of relay 108 to grounded battery. Relay 108 operates and closes a circuit from ground at its front contact and armature, winding of relay 106 to grounded battery. Relay 106 closes the dialing tone circuit by way of source of dial tone 109, right-hand winding of balancing coil 104, conductor 110, normal contact 201 and brush 202 of register 200, conductor 203, normal contact 261 and brush 262 of register controlling switch 260, conductors 275 and 263 to ground at the outer right armature and front contact of relay 106. A tone is induced in the circuit of the right hand winding of the balancing coil notifying the subscriber that he may dial. Relay 106 also prepares the pulse circuit extending from the back contact of relay 107, left-hand armature and front contact of relay 106, conductor 111, winding of relay 264, brush 265 and contact 266 of register controlling switch 260, winding of stepping magnet 203, back contact and armature of relay 204, resistance 205 to grounded battery.

When the subscriber dials the first digit of the office code the circuit of relay 107 is opened a number of times corresponding to the digit dialed. At each interruption of the circuit, relay 107 deenergizes and its armature falls back opening the circuit of relay 108 which, however, is slow to release and remains energized during these short interruptions of its circuit. The deenergization of relay 107 closes ground from its armature to the pulse circuit above traced, causing relay 264 and stepping magnet 203 to operate in series. Magnet 203 releases at the close of each pulse to advance register 200. Relay 264 being slow to release remains energized until the completion

of the series of pulses, when it also deenergizes. The operation of relay 264, closes a circuit from grounded battery, resistance 267, winding of magnet 268, armature and front contact of relay 264, conductor 269 to ground at the inner right armature and front contact of relay 106. Magnet 268 is energized and remains energized, until the deenergization of relay 264 at the close of the series of pulses, releases it to advance the register controlling switch 260 to its next set of contacts. It will be noted that each deenergization of relay 107 also closes a circuit from grounded battery, winding of relay 112, conductor 113, outer left armature and back contact of relay 204, conductor 280, brush 271 and its normal contact 281, back contact and armature of magnet 203, normal contact 266 and brush 265, winding of relay 264, conductor 111, left-hand armature and front contact of relay 106 to back contact of relay 107. Relay 112 energizes and at its right-hand armature closes ground to relay 108 to insure that relay 108 remains energized during the interruptions of its circuit and at its left-hand armature also maintains the circuit of magnet 203 until this magnet completely attracts its armature, thus insuring the operation of magnet 203 and the advance of the register.

With switch 260 in position 2, the pulsing circuit extends from brush 265 and contact 272 of switch 260 through the winding of magnet 231, back contact and armature of relay 204, resistance 205 to grounded battery. Each interruption of the pulsing circuit due to the dialing of the second digit advances register 230 one step. As in the case of register 200, relay 264 remains energized throughout the series of pulses and holds the circuit of magnet 268 closed. At the completion of the series of pulses, magnet 268 releases and advances the register control switch 260 to its third position, in which position the pulse circuit is closed through to the thousands register (not shown). The setting of the numerical registers takes place in a manner similar to that of the code registers and is as shown and described in the above identified Patent No. 1,509,434. The circuit above traced for relay 112 is completed in the second position of switch 260 through brushes 271 and 265 and their second contacts and the armature and back contact of magnet 231 to insure the proper advance of register 230 in response to each impulse.

The actual setting of the registers and translators for a representative two-digit code will now be described.

Assume that the called substation is located in an office called Astor. The code dialed in this case is A—S, which will result in the sending out of two series of pulses.

comprising two pulses and seven pulses respectively. For the arrangement of letters and numbers on a typical dial, reference may be made to Fig. 33, Bureau of Standards circular No. 112, Telephone Service. In this case register 200 comes to rest with its brushes resting on their second off-normal contacts and the brushes of register 230 come to rest on their seventh off-normal contacts. As soon as switch 260 advances to position 3 after register 230 is set, a circuit is closed from ground at the outer right armature and front contact of relay 106, conductors 263 and 275, brush 273 and contact 274, conductor 282, normal contact of relay 206, winding of relay 206 to grounded battery. Relay 206 operates and closes a locking circuit for itself by way of its inner right armature and front contact, contacts of sequence switch cam 210, conductor 263 to ground at the outer right armature and front contact of relay 106. At its outer left hand armature relay 206 closes a circuit from ground on conductor 263 to conductor 207, brush 208 and its second off-normal contact 209, brush 232 and its seventh off-normal contact 233, conductor 234, to contacts on arcs 306 and 326, 316 and 336, 346 and 366, 356 and 376 of the translator switches 300, 320, 340, and 360 thus marking these contacts with ground. The circuit for magnet 307 may be traced from grounded battery, winding of magnet 307, armature and back contact of stop magnet 308, inner right-hand armature and back contact of relay 380, conductor 381 outer right-hand armature and front contact of relay 206 to ground. The circuit for magnet 327 may be traced from grounded battery, winding of magnet 327, armature and back contact of stop magnet 328, outer right-hand armature and back contact of relay 380, conductor 382, inner right-hand armature and front contact of relay 206 to ground. The operation of magnets 307 and 327 moves the brushes of switches 300 and 320 over their contacts. When contacts 317 and 337, which are grounded by means of circuits previously described, are reached a circuit is completed from the ground on the contact 317, brush of arc 316, outer left armature and back contact of relay 383, inner left armature and back contact of relay 380 inner armature and back contact of relay 384, winding of stop magnet 308, resistance 309 to grounded battery. A similar circuit is completed from ground on the contact 337, brush of arc 336, inner left armature and back contact of relay 383, outer left armature and back contact of relay 380, outer left armature and back contact of relay 384, winding of stop magnet 328, resistance 329 to grounded battery. Although contacts 310 and 330 are also marked with a ground the circuits through the brushes of arcs 306 and 326 are open at the left armatures of relay 383 and no circuit

can be closed through these contacts. The stop magnets 308 and 328 operate, opening the circuit of rotary magnets 307 and 327 thus bringing the translator switch to rest on the selected row of contacts.

Had the desired office been ESsex — register 230 would have stopped in the same position but register 200 would have been brought to rest on its third off-normal contact. With the registers in these positions ground is again placed on conductor 234. However, with register 200 on its third contact and the register control switch in position 2 or beyond, a circuit is closed from grounded battery, winding of relay 383, conductor 385, contact 212 and brush 213 of register 200, contact 270 and subsequent contacts and brush 262 of register control switch 260, conductors 275 and 263 to ground at the outer right armature and front contact of relay 106. Relay 383 operates in this circuit. With the register set as above the same set of contacts is marked with ground on translator arcs 306, 316 etc. The circuits of stop magnets 308 and 328, however, lead by way of the back contacts and armatures of relay 384 and left back contacts and armatures of relay 380, and the left alternate contacts of relay 383 to the brushes of arcs 306 and 326 respectively. Therefore the stop magnets operate when the rotary contacts 307 and 327 have brought the brushes of translators 300 and 320 to contacts 310 and 330 instead of contacts 317 and 337.

The operation of setting the translating devices when a three-digit office code is dialed will now be described.

Assume that the preliminary digit used for the special three-digit code is 9. This may be incorporated in the number as listed in the directory either as a preliminary number, for example, 9 ERie —; or a letter designation may be used, thus WESton —; or to avoid confusion for the subscriber who may have become accustomed to dialing only two code digits, the number may be written WESton 7 —, followed by the usual four digit number.

Assume then that it is desired to reach a subscriber in the office whose code as indicated above corresponds to the digits 9—3—7. The dialing of the digit 9 will cause register 200 to be set upon its ninth off-normal contact in which position a circuit is closed from grounded battery, resistance 267, winding of magnet 268, conductor 276, contact 214 and brush 215 of register 200, conductors 275 and 263 to ground at the outer right armature and front contact of relay 106. This circuit prevents the release of magnet 268 at the completion of the first set of pulses, holds switch 260 in its first or normal position, and permits the second series of impulses to advance the brushes of register 200 onto the second half of its bank. It

may thus be seen how the dialing of a predetermined digit will permit the registration of a plurality of digits on a given register.

If the second digit dialed is three, the brushes of register 200 will advance to their twelfth terminal at which time they will come to rest, and since the above traced holding circuit of the register control switch 260 has been opened this switch will advance to its second position. The third series of impulses corresponding to the digit 7 will place register 230 on its seventh terminal. A circuit for again placing ground potential on conductor 234 and the corresponding contacts of the translator test banks is prepared. With register 200 positioned on the second half of its bank a circuit is closed as soon as relay 264 releases at the close of the second series of impulses. This circuit extends from ground at the inner right armature and front contact of relay 106, conductor 269, right normal contact of relay 264, conductors 277 and 216, brush 217 and its twelfth contact (or any contact from 11 to 18), conductor 218, winding of relay 386, winding of relay 380 to battery and ground. Relays 386 and 380 operate in this circuit. Relay 386 closes a circuit extending from ground at its outer right armature and front contact, winding of relays 387 and 388 in series, to battery and ground. The same ground extends to relay 384 by a branch circuit. These three relays also operate. The operation of relays 386, 387 and 388 opens the selection controlling paths to the arcs of translator switches 300 and 320 and closes the paths to the arcs of translator switches 340 and 360. The operation of relay 380 transfers the energizing circuits to be closed by relay 206 from magnets 307 and 327 to magnets 347 and 367, while the joint operation of relays 380 and 384 transfers the stop circuits from stop magnets 308 and 328 to magnets 348 and 368. The setting of the register 200 on its twelfth contact also completes the previously traced circuit for relay 383 which operates. Thus it may be seen that the positioning of register 200 on a set of contacts in the second half of its bank by two series of impulses brings translator 340—360 into use instead of translator 300—320.

Relay 206 is operated as before as soon as register control switch 260 advances to position 3 to close ground from conductor 263 through the registers to terminals 350 and 370 and also to close the circuits for the rotary magnets 347 and 367 of the translator 340—360. The circuit of magnet 347 may be traced from ground, outer right armature and front contact of relay 206, conductor 381, inner alternate contact of relay 380, armature and back contact of stop magnet 348, winding of magnet 347 to battery

and ground. The circuit for magnet 367 may be traced from ground, inner right armature and front contact of relay 206, conductor 382, outer alternate contact of relay 380, armature and back contact of stop magnet 368, winding of magnet 367 to battery and ground. When the brushes of arcs 346 and 366 reach the grounded terminals 350 and 370 a circuit is completed from ground at the terminal 350, brush of arc 346, inner alternate contact of relay 383, inner left armature and front contact of relay 380, inner armature and front contact of relay 384, winding of stop magnet 348, resistance 349 to grounded battery. A circuit is also completed from ground on the terminal 370, brush of arc 366, outer alternate contact of relay 383, outer left armature and front contact of relay 380, front contact and outer armature of relay 384, winding of stop magnet 368, resistance 369 to grounded battery. Magnets 348 and 368 operate, opening the circuits of rotary magnets 347 and 367 and bringing the brushes to rest on the desired set of terminals.

As soon as the brushes of either translator come to rest on grounded terminals, circuits are completed from the grounded terminals on the hunting arcs, right contacts of relay 383, left contacts of relay 380; conductors 389 and 390 to the winding of relays 278 and 279. These relays operate and lock up to ground by way of conductor 381 and the outer right armature and front contact of relay 206. Relay 279 provides a substitute holding ground for relay 206 at its inner left armature and front contact, and the joint operation of the two relays closes circuits for advancing the sender and sender control sequence switches (not shown) to their next positions in which circuits are closed by which the translator controls the selection of the desired office. The operation of these sequence switches is the same as that of the corresponding switches in the disclosure of the above mentioned Patent No. 1,509,434.

The method of absorbing a single impulse such as might arise from an accidental movement of the switchhook is of interest. With the register control switch 260 in its normal position and register 200 in position 1 (which would result from a single interruption of the circuit), a circuit may be traced from ground at the outer right armature and front contact of relay 106, conductors 263 and 275, brush 215 and its first off-normal contact 219, conductor 276, winding of register control magnet 268, resistance 267 to grounded battery, holding the magnet operated and preventing its release to advance the switch to its next position. At the same time a circuit is closed from grounded battery, right winding of relay 204 first contact 220 and brush 217 of regis-

ter 200, conductors 216 and 277, normally closed contact of relay 264, conductor 269 to ground at the inner right armature and front contact of relay 106. Relay 204 operates and at its right armature opens the circuit of magnet 203. When relay 107 again falls back in response to an interruption of the line circuit, a circuit is completed from ground, armature and back contact of relay 107, left armature and front contact of relay 106, conductor 111, winding of relay 264, brush 265 and contact 266 of register control switch 260, inner left-hand armature and front contact and left winding of relay 204, resistance 221 to battery and ground. Relay 264 operates and at its left armature closes the circuit for magnet 268 and opens the original energizing circuit of relay 204. Relay 204 remains energized in the above traced circuit through its left winding until the end of the pulse when it releases. Relay 264 being slow to release does not close its back contact until after the relay 204 has released and closed the battery lead to magnet 203. If this pulse is followed by a series of pulses, the next pulse causes the energization of magnet 203, and advances register 200 to its second position and the rest of the action proceeds as before. Should the second pulse also be a false or single pulse so that relay 264 deenergizes directly after it, magnet 203 is not energized and brushes 215 and 217 remain on their first off-normal contact so that the holding circuit for magnet 268 is maintained and the circuit for relay 204 is closed again as soon as relay 264 deenergizes and remains closed until such time as a series of impulses is received or the subscriber hangs up.

With translator 300—320 or 340—360 positioned upon the set of contacts marked by ground on arcs 306 and 326 or 316 and 336, etc., circuits are completed through the various arcs for performing the necessary functions involved in selecting the desired office. One arc controls the setting of a switch in accordance with the class of call. Other arcs have their contacts connected to counting relays for controlling the selection of the proper brush and group on the district selector, and the proper brush and group on the office selector. At the same time other arcs connect resistances into the fundamental circuit to equalize the resistance introduced as soon as selection progresses beyond the district selector. Other arcs have their terminals connected to advance the sender sequence switch through the positions for office selection, where the destination sought is reached directly by the district selector and so on. For the manner in which these functions are carried out reference is made to the above-mentioned Patent No. 1,509,434. As the func-

tion of the translator forms no part of the present invention the wiring of the arcs and the complete wiring of the brushes has not been shown. A part of the wiring of the
5 brushes has been shown to indicate that the operation of the relays which discriminate between the translators 300—320 and 340—360 connects all the brushes of the active translator to the corresponding leads.

10 As soon as the translator has been set and the sender and sender control sequence switches have advanced in response to the energization of relays 278 and 279, cam 225 of the sender control sequence switch is
15 closed. A circuit is established from ground, cam 225, brush 226 and an off-normal contact, armature, back contact, and winding of magnet 203, armature and back contact of relay 204, resistance 205 to
20 grounded battery, thus forming a self-interrupting circuit for magnet 203 to restore switch 200 to normal. When this switch reaches its normal position the ground on cam 225 is extended by way of brush 226
25 and its normal contact to brush 236 and its off-normal contacts, armature, back contact and winding of magnet 231, armature and back contact of relay 204, resistance 205 to grounded battery. Magnet 231 operates in
30 this self-interrupting circuit and steps register 230 back to normal.

As soon as selection is completed the circuit of relay 107 is opened by the district selector and this relay deenergizes. The de-
35 energization of relay 107 releases relay 108 which closes ground to conductor 114, brush 283 of register control switch 260 and its off-normal contacts, conductor 284, armature, back contact and winding of magnet 268,
40 resistance 267 and grounded battery, forming a self-interrupting circuit for magnet 268 which steps the register control switch back to its normal position. Upon the return of the register control switch to normal
45 the sender control switch is advanced and cam 210 is opened, releasing relays 278, 279 and 206, after which the sender and sender control sequence switches are restored to normal and the sender is in condition to
50 serve a subsequent call.

The translator switches have no normal position, but remain in any given position until advanced by the operation of the rotary magnets in accordance with subsequent
55 setting of the registers.

What is claimed is:

1. In a switching system, a plurality of switches, switch controlling devices operated in response to series of impulses, and
60 means for discriminating between said switches in accordance with the number of said series of impulses.

2. A set of registering devices, means to position said registering devices in response
65 to a variable number of series of impulses,

and a translating device positioned under the joint control of said registering devices.

3. In a telephone system, means for generating current impulses, a series of automatic switches positioned by series of current impulses, a control device normally operated to direct a single series of impulses to each of said switches in turn, and means whereby said control device may be operated to direct a plurality of series of impulses to
70 a given switch. 75

4. In a telephone system, a series of automatic switches positioned by series of current impulses, a control device normally operated to direct a single series of impulses to each of said switches in turn, and means for holding said control device in one position while a plurality of series of impulses are directed to one switch. 80

5. In a telephone system, a plurality of automatic switches, a multi-position control device, means for normally operating said control device to direct a single series of impulses to a different switch in each position thereof and means for holding said
85 control device in its first position while two series of impulses are directed to the first of said switches. 90

6. In a telephone system, a plurality of automatic switches, a multi-position control device, means for normally operating said control device to direct a single series of current impulses to a different switch in each position thereof, and means responsive to a preliminary series of impulses of predetermined number to hold said control device in its first position while a second series of impulses is directed to the first of
95 said switches. 100

7. In a registering system, a pair of registering devices each normally positioned by a series of current impulses, and means whereby the first of said registering devices may be positioned by two series of current impulses and the second of said registering devices may be positioned by a third series of current impulses. 105

8. In a registering system, a registering device normally positioned by a single series of current impulses in one group of positions and means whereby a predetermined preliminary series of impulses will cause said device to be positioned in a second group of positions by a second series of impulses. 110 115 120

9. In a selection controlling system a plurality of selector switches, a plurality of registers, means for positioning each of said registers by a single series of impulses to control the setting of said switches in one group of choices and means for positioning said registers by a number of series of impulses greater than the number of registers to control the setting of said switches in other groups of choices. 125 130

10. In a selection controlling system, a plurality of selector switches, a plurality of registers, means for positioning each of said registers by a single series of impulses to control the setting of said switches in one group of choices, means to position said registers by a number of series of impulses greater than the number of registers to control the setting of said switches in other groups of choices and means to determine the group of choices within which said switches are to be set in accordance with the number of series of impulses employed in setting the registers.

11. In a selection controlling system, a plurality of selector switches, a plurality of registers each normally positioned by a single series of current impulses, a translator normally operated to prepare circuits determined by the joint positioning of said registers to control the setting of said switches within one group of choices, means to position said registers by a number of series of impulses greater than the number of said registers and to operate said translator to control the setting of said switches within a second group of choices.

12. In a selection controlling system, a plurality of registers each normally positioned by a series of current impulses, means whereby one of said registering devices may be positioned by a plurality of current impulses, a translating device and means for variably operating said translating device in accordance with the number of series of impulses used to position said registers.

13. In a selection controlling system, a

primary register having two sections, and a secondary register each normally positioned by a single series of current impulses, a translator normally operated to prepare circuits determined by the joint position of the primary and secondary registers to control selection within one group of choices, and means operative by a preliminary series of impulses of predetermined number, to position said primary register in its second section and to operate said translator to control selection within a second group of choices.

14. In a selection controlling system, a primary register having two sections, and a secondary register each normally positioned by a single series of current impulses, a register controlling device for directing the series of impulses to the primary and secondary registers in turn, and advancing at the close of each series of impulses, a translator normally operated to prepare circuits determined by the joint positioning of the primary and secondary registers to control selection within one group of choices, and means operated by a preliminary series of impulses of predetermined number to hold said register controlling device in its first position during a second series of impulses to position said primary register in its second section and to operate said translator to control selections within a second group of choices.

In witness whereof, I hereunto subscribe my name this 7th day of March A. D. 1923.

HARRY C. CAVERLY.